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ORIGINAL MEMOIRS.

GASTROCOLOPTOSIS.*

ITS PATHOLOGICAL SIGNIFICATION AND ITS SURGICAL TREATMENT.

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I. PATHOLOGICAL SIGNIFICATION.

FOR the subject of this paper I have chosen a question upon which American and Danish surgeons have for many years worked with the same object in view, and, in principal, with the same methods. While the majority of the surgeons of Europe and almost the entire medical world have no comprehension of the enormous pathological significance of gastrocoloptosis nor, in consequence, of the therapeutic problems which here present themselves, gradually, every one has now begun to agree about one thing: that a large number of those individuals with whom one finds gastroptosis and coloptosis suffer to a great extent from a series of symptoms of which constipation is the first and most constant, while cardialgia, vomitings, emaciation, and a host of nervous symptoms are added little by little, and complete the aspect of the disease of these wretched patients. But here unanimity ceases, because, while I and probably all, who are votaries of a surgical therapy with the severe cases of ptosis, regard the above-

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mentioned morbid symptoms as a result of the ptosis, the others regard the ptosis as an irrelevant, co-ordinate symptom. This difference of opinion corresponds with and rests on the diversity which prevails in the conception of the pathogeny of enteroptosis. Essentially there are two theories which have governed the medical men's conception of ptosis as a secondary, rather insignificant phenomenon: the one, Glénard's theory, tends to show that enteroptosis is the result of an enigmatic nutritive disease, a "diathèse hépatique," which involves atrophy and prolapse of the small intestines, whereby the organs lying above lose their support, which secondarily leads to gastroptosis, hepatoptosis, etc. This theory has now been abandoned by most in favor of Stiller's hypothesis which, in place of Glénard's mysterious liver-disease, sets up a so-called congenital, universal asthenia, a congenital weakness, laxity, and gracility of the entire structure of the body, as of the individual tissues. The ptosis and the constipation should be due to laxity and atony of the tissues, the pains and the nervous symptoms to neurasthenia—the whole simply being a manifestation of degeneration, and, as degeneration cannot be cured, it is natural that all votaries of this doctrine must regard a surgical therapy for enteroptosis as senseless.

I think, however, that one is justified in expressing a certain wonder that Stiller's hypothesis is accepted unreservedly and without criticism by the majority of physicians the world over, because there is one fact, which, even where Stiller's theory is regarded quite superficially, seems to deliver a *coup-de-grâce.* It is the circumstance *that enteroptosis is so rare with men and so very frequent with women that it must almost be considered a feminine disease par excellence.* But even the most conceited and discourteous of men will not insist on this degeneration being reserved for women. Unfortunately we certainly have to admit that, in this respect, the two sexes have nothing to reproach each other with. Nor is there any lack of thin, badly built, neurasthenic men; but it is very seldom that these suffer from constipation and the dyspeptic symptoms which characterize the ptosis patients.

Simple logic tells us, therefore, that Stiller's theory is in the main at fault, and tells us to look around for another explanation of the overwhelming frequency of ptosis with women. In my opinion a very simple explanation is found in two circumstances peculiar to women: (1) their misuse of corsets and lacings, and (2) the changes which pregnancy and childbirth involve in the intra-abdominal pressure. Here we have the two momenta which fully explain enteroptosis as a feminine disease par excellence: the one causes an active subsidence of the subdiaphragmatic organs and stretches and lengthens the suspensory ligaments, while the other removes that support which the intestines, when compressed by a vigorous abdominal wall, offer the subdiaphragmatic organs. The two Russian investigators, Wolkow and Delitzin, are surely right when in their excellent work on nephroptosis they compare the small intestines to an air-filled pelotte which, so long as it is supported by the elastic pressure of a vigorous muscular abdominal wall, bears up the subdiaphragmatic organs: the stomach, the liver, and the kidneys. When, after many childbirths, the abdominal wall becomes like a sort of slack bag into which the small intestines subside, then the organs mentioned not only lose their support but are dragged, sucked, and drawn downward. Their power of resistance against this then depends entirely on the firmness and solidity of the ligaments and peritoneal duplicatures by which they are attached to the diaphragm. If these are feeble, thin, and atrophied as with Stiller's degenerated type of mankind, or lengthened by the use of corsets and lacing, and the organs forced down, the ptosis proceeds rapidly,

Of Stiller's theory, then, there remains only this: that the corset and lace pressure, when brought to bear upon quite young, half-grown girls with soft, relaxable ribs, naturally has specially easy play with the degenerative type, the bones and tissues of whom are particularly relaxable and flaccid. Among ptosis patients we therefore find many of this female type represented, and this explains, to a certain extent, the origin of the theory, but is no excuse for the complete regard

which has been paid to it, because, for that ptosis is a too frequent phenomenon with originally quite normal women.

The rare cases of ptosis with men almost all occur with men of Stiller's type, men with a feeble bone and muscle structure, and then generally with men who have used tightly buckled belts.

But if we have thus had to abandon the theory of degenerative universal asthenia as the cause of the ptoses, then we must also abandon the idea of constipation, cardialgia, vomitings, emaciation, nervous symptoms, etc., being the outcome of "degenerative asthenia." It is most natural, therefore, to ascertain whether all these symptoms cannot be explained as pains released and caused by the ptosis itself.

Even in that article in "Hospitalstidende," in which in 1898 I reported my first case of gastropexy, which led to a permanent cure of the considerable sufferings of this ptosis patient, I set forth in its main features the conception that all the morbid symptoms and conditions which we find typical in patients with enteroptosis allow themselves naturally and spontaneously to be explained as a result of the ptosis. The correctness of this conception has only been confirmed by the observation and study of the 400 cases which I have personally treated, the statistics of which are embodied in the present communication.

In order to substantiate this, I shall give a short description of the aspect of the typical symptoms which I have found with gastroptosis, and of their development.

Confining the discussion, for the present, to gastrocoloptosis with women, I discriminate between two principal groups, which, both as regards the pathogeny and the symptomatology, are rather sharply distinguished from each other; they are *virginal* ptosis and *maternal* ptosis.

II. Virginal Gastrocoloptosis.

Symptomatology.—In the course of the first or second year after the commencement of puberty, and when the wearing of corsets commences, the previously healthy individual

begins to suffer from *persistent constipation,* whereto are quickly added weariness, headache, loathing of food. In addition to these symptoms there occurs after some time cardialgia, in the form of severe pains which are always situated to the left of the centre line and occur as soon as the patient partakes of food. The quality of the food has no significance so far as the rise of these pains is concerned, whereas the quantity—the mass and weight of the food—is of great importance, for which reason these patients can only get along by taking many quite small meals during the 24 hours. In many instances the commencement of the pains is accompanied by vomiting, and with a smallish group of these patients each meal was invariably and immediately succeeded by the discharge of a part or the whole of the food partaken of. In the first instance, the patients may maintain an astonishingly healthy appearance for many years; but if they disgorge everything, and are furthermore frightened by fear of the pains from attempting to eat, emaciation sets in, which may often reach an extreme stage and present that aspect which I have called gastroptosis-cachexia, and which may result in the death of the patient as a consequence of inanition.

By examining the chemical function of the stomach one generally finds that the measure of acidity is normal, but in a certain number of cases one finds achylia, and in others, conversely, hyperacidity and even gastrosuccorrhœa.

In more than half of the cases the motor function is completely normal, inasmuch as the stomach empties itself entirely in the course of 4–5 hours. In 30–40 per cent. of the cases there is a slight delay (5–7 hours), while food remains are rarely found 8 hours after one of Bourget's experimental meals.

With many of these patients a whole series of nervous symptoms develop gradually as a result of this state of autointoxication and inanition, such as oppression across the loins, in the pelvis and the abdomen, clammy hands and feet, palpitation of the heart, physical depression; with some a mental relaxation and with others a sensation of dread.

Finally disturbances in the function of the genital organs develop very rapidly, because the menstruation becomes irregular and is accompanied by diffuse pains in the abdomen and a deterioration of the regular symptoms. The menstruation is frequently very deficient, and for years may entirely fail to appear.

The *pathogenesis* of this disease as shown by its symptoms is, in my opinion, as follows: the lacing up of the young girls' gracile, easily relaxing, and plastic body in corsets involves an increasing deformation and straitening of the lowest thorax aperture. This results in a shifting of the subdiaphragmatic organs. First of all the pressure acts upon the massive liver, and this again by its great weight serves to dislocate the organs lying below. Paul Hertz has shown us in a very fine manner how nephroptosis arises from corset pressure, because this utilizes the liver as a lever to tilt the right kidney out of its niche, and we therefore understand why in the majority of cases the floating kidney is only on the right side. But to what a still greater extent, and how more invariably must not the effect of the corset pressure on the liver extend to the stomach?

It is clear that if the liver is pushed down the stomach must follow suit, and hereby the œsophagus, the gastrophrenic ligament, and the cardial peritoneal covering *in toto* are stretched in a manner which corresponds with the extent of the subsidence. In this I perceive the cause of the invariable pains in the left side of the epigastrium, of which these patients always complain when they are up and doing, and especially so during meals. But, in addition, the posterior edge of the gastrohepatic and hepaticoduodenal ligaments must also become lengthened and dislocated. Together with the stomach, the transverse colon is pushed down, whereby more or less acute angled bends occur at the points of fixation at the hepatic flexure and the splenic flexure. This involves a hindrance of the passage of the fæces from the colon ascendens to the colon transversum; and, if they enter the latter, they will again be retained here for an abnormally long time, and then

the hard, gnarled fæces still further and continuously weigh down the transverse colon. Hence the ever increasing constipation.

I look for the cause of the virginal ptosis patients suffering so much more than the maternal ptosis patients do from pains and vomitings after meals to the circumstance that the tight abdominal wall and the narrow abdominal cavity do not permit of the free subsidence of the loosened organs. The result is that the stomach as well as the colon fold themselves transversely with the longitudinal axis, and breaks and bends occur which hinder the natural passage of the food and produce stasis and pains. The fact of the matter is, that all the vessels and nerves to the stomach from the large vessel- and nerve-roots have their course just between the peritoneal layers, which either form the suspensory ligaments or cover these. They form, so to say, an integral part of the suspensory ligaments and, when these are folded, are also subject to bends and folds, and when the ligaments are stretched and lengthened by the subsidence of the stomach a considerable drag is also exercised on the vessels and nerves. That such a distention of the sympathetic fibres and thereby of the ganglion cœliacum and of nervi-vagi, which, with the œsophagus, extend into the thorax cavity, cannot fail to affect the activity of these nerves seems evident, and here, surely, is to be found the explanation of many of the nervous symptoms of these patients. As regards the invariable pains in the left side of the epigastrium, it seems to me that these are explained naturally as having their origin in the drag on the sensitive nerves which have their course in the subperitoneal tissues.

In these conditions we have a simple explanation of the pains and disgorgements of the virginal ptosis patients immediately after partaking of food; and, if these symptoms become invariable, the consequent results are emaciation and waste of fatty and other tissues in the abdominal organs, which makes room in the abdomen for a further subsidence of the subdiaphragmatic organs, and makes the suspensory ligaments of these thinner and more relaxable. But, by this the subsidence

of the colon is increased, and the constipation by degrees becomes more obstinate. With the resorption of the stagnant fæces a poisoning of the organism arises—autointoxication; but this is not all, because the stagnation in the large intestine reacts on the function of the small intestine. The passage through the small intestine takes place more slowly, and, in certain cases, a real stasis may even occur in this. This may perhaps, as assumed by Lane, be due to bends in the small intestine at its points of fixation (the duodenal kink and the iliac kink) where the subsided part of the intestine joins the fixed part; or, as Knud Lunn thinks, may be only a result of the constipation, especially where valvula bauhini are deficient.

According to Lunn's observations, then, it seems as if the stasis is transmitted to the stomach, and we then get the delayed emptying of this, five to seven hours after the meal, which often occurs with gastroptosis patients, and which is interpreted by certain authors as a " primary atony," and even by Stiller is considered as being the cause of the ptosis.

The view of the matter is entirely beyond the point, because in more than half of the cases of gastroptosis the emptying is perfectly normal. The delayed emptying, on the contrary, which occurs with the minority of ptosis patients seems to me rather to be explained naturally by the difficult conditions of passage in the large and small intestines.

The *diagnosis* of the virginal ptosis is generally not difficult for him who has once had his eyes opened to the peculiarities of the aspect of the disease, but for him who has not it offers many difficulties and stumbling blocks. Certain it is that few diseases are so frequently misinterpreted as this. The three wrong diagnoses under the flag of which virginal ptosis most frequently sails are (1) *ulcus ventriculi,* (2) *colitis,* and (3) *nervous disease of the stomach or hysteria.*

Those cases where violent cardialgia and vomitings occur as an immediate result of meals and dominate the aspect are naturally confounded with ulcus ventriculi. This confusion happens all the more easily because the violent and frequent vomitings by no means rarely show streaks of blood, or even

such a strong admixture of blood that they assume the character of hæmatemesis. The presence of constipation, indeed, only strengthens the diagnosis, because it is so often a symptom with ulcus.

In addition to this the examination of the position of the stomach by scraping auscultation, or by Röntgenoscopy after a bismuth meal often reveals a subsidence which is inferior in proportion to the acute symptoms. With most cases, this seems to controvert the diagnosis, inasmuch as these cases mean quite plainly that the acuteness of the symptoms must be proportionate with the degree of the extent of the subsidence. Not until one has realized that it is just the circumscribed conditions of space which hinder the pressed-down stomach from freely sinking down and, on the contrary, jam it between the tight abdominal wall, the spinal column and the other abdominal organs, and force it to place itself in bends and folds, does one understand that these very circumstances, in spite of the apparently minor ptosis, produce such acute symptoms.

The differential diagnosis from ulcus is, as a rule, easily determined from the following facts: (1) *The seat of the cardialgia* being to the left of the centre line, (2) that the cardialgia does not depend on the quality of the food, but does on the quantity of this. An ulcus patient suffers pain from eating rich, sour, spiced food, no matter how small the quantity, but stands milk; while a ptosis patient stands all such food equally well so long as the quantities are quite small, but suffers severe pain from milk and other neutral food when the quantity is too large.

(3) *The influence which the position of the body has upon the symptoms.* These always are worse in an upright position, and always improve and often disappear entirely only with confinement to bed.

The cases where constipation dominates the aspect of the disease, while the stomachic symptoms are comparatively minor, are often confounded with colitis. In many cases the confusion is promoted by this, that the constipation involves

in reality a colitis with periodically occurring diarrhœa. Here, also, it is a differential diagnostic symptom of great value: that with ptosis, confinement to bed has a highly favorable effect on the constipation; while constipation arising from other causes generally becomes more marked with confinement to bed.

The diagnosis hysteria and nervous disease of the stomach is generally given with such patients as have for a long time been vainly treated with ulcus-therapy or anticonstipation treatment, partly because their having been vainly treated for a supposed organic disease leads to the diagnosis of functional neurosis, and partly because these patients, little by little, on account of their protracted sufferings and the fruitless treatment, become in a great degree psychically exhausted and nervous individuals. The differential diagnosis from hysteria is, however, by no means difficult, when one analyzes the history and the aspect of the disease; because it then always appears that constipation and dyspepsia have been the first symptoms and still constitute the central feature in the aspect of the disease. Scraping auscultation and Röntgenoscopy show us the presence of the ptosis, and, finally, an exact examination shows that really hysterical stigmata are practically always wanting.

More rarely the pure ptosis is confused with cancer. This happens with those patients who have become completely emaciated by vomitings and abhorrence of food, lasting over many years, and who have acquired a cachectic complexion from the autointoxication arising from the stagnating contents of the large intestine.

Complications and Consequent Diseases.—Some of my observations indicate that the traction on the œsophagus of the subsided stomach may involve a difficulty with the swallowing and passing of the food, and thereby, also, changes in the œsophagus itself. It is peculiar to a rather numerous group of patients with virginal ptosis that they either permanently or periodically, especially when in an erect position, disgorge the food immediately after swallowing it. In other instances

I have observed the trouble with swallowing to be so serious that the patients have been admitted for stricture of the œsophagus. That these cases are really due to the traction of the stomach on the œsophagus seems proved by this, that the symptoms mentioned disappeared immediately and completely in all the cases after gastropexy or after the employment of an effective supporting belt.

As regards the stomach itself, the folds and bends mentioned, which, with virginal ptosis especially, are the result of the narrow space, give rise to serious and interesting complications and to the consequent conditions.

I have already mentioned that, even where no trace of ulcus can be proved at the operation, hæmatemeses are not quite infrequent with gastroptosis. Such hæmatemeses are probably due to stasis in and swelling of the mucous membrane at the places where the wall of the stomach is creased.

Finally, in a certain number of cases, the virginal ptosis leads to the development of an hour-glass stomach. I think, indeed, that I dare assert that the solution of the so long disputed question of the pathogenesis of the hour-glass stomach is to be sought for in the fixation of the creases of the prolapsed stomach caused by corsets and laces. The two theories which have hitherto stood in opposition to each other are, as is known, the conception that the hour-glass stomach is a congenital deformity as opposed to the ulcus-theory, according to which the hour-glass form should be due to cicatricial shrinkage. Without venturing to deny the justifiableness of these two explanations with individual cases, I venture distinctly to insist that neither of them can be accepted as accounting for the great number of this astonishingly frequent disease; because, if a congenital hour-glass is proved at all, it is proved, at the highest computation, only in one or two cases, of which the demonstrative force is doubted even by Moynihan, the advocate of the ulcus-theory. Now, as regards this, it may, when considered superficially, seem to be well founded in the fact that, with an hour-glass stomach, ulcerations or cicatrices are often found on the partition wall.

But further reflection shows that the theory does not stand the test.

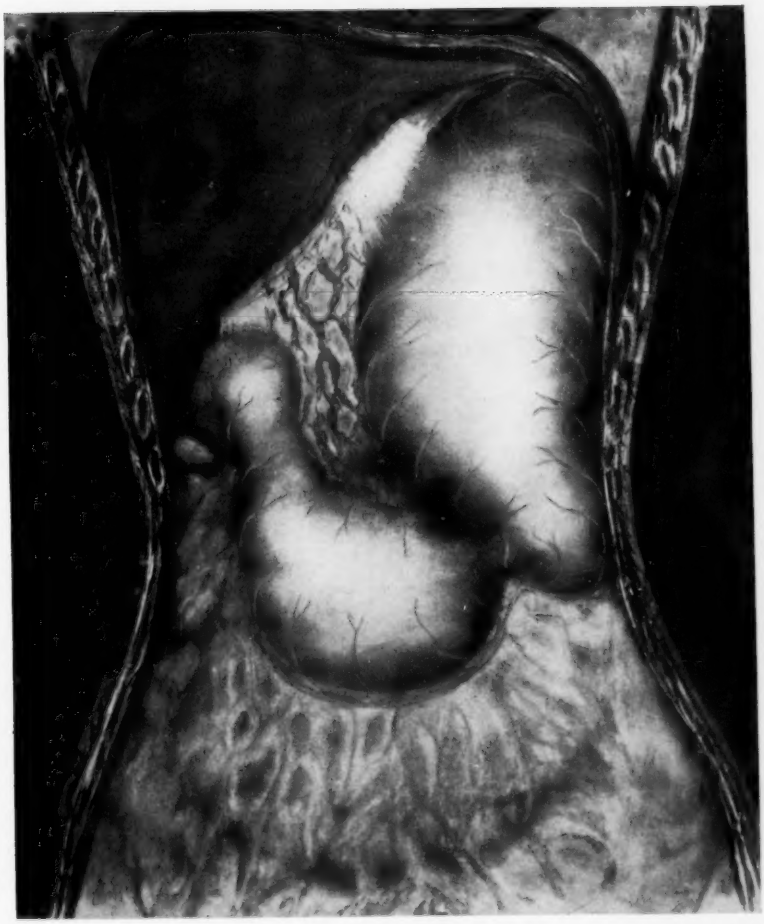
The fact that we find an ulcus or a resultant cicatrix is really no proof that the ulcus is primary, because the hour-glass stomach itself, on account of the hindrance of the passage and on account of the stagnation and decomposition of the contents of the stomach, is greatly disposed to the development of ulcerations.

Especially is there far more reason to believe that ulcus is secondary in the majority of cases where such ulcerations occur in the proximal part of the stomach. But in a great number of cases neither ulcus nor cicatrices occur!

There is, in addition, another fact, which is generally overlooked by most authors and which entirely precludes the correctness of the ulcus-theory. What I am aiming at is this, that, while ulcus rotundum ventriculi is equally frequent with males and females, the serious forms which ought to be demanded for the development of such thorough changes are even more frequent with men than with women, the hour-glass stomach being such a rare phenomenon with men that it must most appropriately be called a female disease. Here, so to say, the conditions quite resemble those of gastroptosis. It was just this which directed my thoughts toward the possibility of the solution of the enigma, which the pathogenesis of the hour-glass stomach presents, lying in gastroptosis.

The study of the clinical features and my operative experience have greatly strengthened this supposition. An investigation of the history of the disease as regards 26 cases of hour-glass stomach which I have personally observed shows that the first symptoms of the disease have always occurred during the years of puberty, when the subsequent, simultaneous misuse of the corset and the tight lacing commence. In their main features these symptoms entirely resemble those of virginal ptosis. Little by little the increasing hindrance of the passage, the retention, and the dilatation in the proximal part of the stomach are maintained as an aspect of the disease, and, if hæmatemesis and melæna occur in consequence of develop-

FIG. 1.



Hour-glass stomach, resulting from the folds growing together with their peritoneal surfaces.

FIG. 2.

Hour-glass stomach cut through.

ing ulcerations, the aspect becomes more and more that of ulcus stenosis.

By my numerous operations for gastroptosis I have been able to observe all the stages of the development of the hour-glass stomach, in consequence of which I have formed in my own mind a consecutive view of this.

With virginal gastroptosis the bends of the creases occur essentially and naturally in two places: (1) on the lesser curvature at the transition between pars cardiaca and corpus ventriculi in the very place where the triangular solid ligamentum gastrophrenicum (called by some pars condensa omenti minoria) ceases and is relieved by the more elastic portion of omentum minus; (2) on the medial edge of ligamentum-hepaticoduodenale where the free portion of the duodenum (with the pylorus) bends toward the fixed part.

The hour-glass formation is generally due simply to the fine adhesions which form themselves in the folds of the serosa surfaces which rest one upon the other (see Figs. 1 and 2).

The development is sometimes greatly favored by this, that the omentum minus by coalescing with the omentum majus assumes a lace formation. With gastroptosis we very frequently find a complete loosening of the omentum minus, the central part of which subsides and hangs over the anterior side of the stomach like a tongue-shaped clump of the omentum. It may then come in contact with the tip of the omentum majus, and coalesce with this in a ribbon which draws a deep furrow in the stomach. The adhesion mentioned as occurring between the peritoneal surfaces, which I have seen in all stages, from those which commence extensively and are easily loosened to those which are hermetically soldered, fixes the ptosis creases, and these, like partition walls, protrude into the lumen of the stomach.

I have dwelt so explicitly on the aspect and pathological importance of virginal ptosis because it is still so unknown and so misunderstood, though it is now 14 years since I described it for the first time. Far better known is the other form.

2. THE MATERNAL GASTROCOLOPTOSIS.

This is the form we find with women whose abdominal wall consequent to past pregnancies and confinements has become distended, roomy, and relaxed. Hereby the intra-abdominal pressure is altered, and the support which the air-filled intestines offered to the subdiaphragmatic organs as long as the vigorous elastic abdominal wall acted fails.

With women whose stomachs lie in a normal and secure position at the moment when the relaxation of the abdominal wall commences, it depends entirely upon the strength of the ligaments whether a gastroptosis ensues at all. With strong women this does not occur; but with others, whose abdominal wall is less capable of resistance, a ptosis develops little by little; the development differing from the virginal ptosis in this, that the coloptosis is generally primary. The transverse colon, which is no longer borne up by the small intestine pelotte, is weighed down by the heavy fæces so that it hangs like a downward convex festoon suspended by the two flexures. The pull firstly affects the gastrocolic ligament and the mesocolon, which are elongated and dragged downward. It is quite common to find the gastrocolic ligament elongated to 3–4 times its normal length, when it is quite thin and perforated in many places. Secondly, it affects the stomach, the suspensory apparatus of which is also little by little stretched and elongated. The constipation and accumulation of fecal matter in the colon resulting from the coloptosis affects with steadily increasing strength the downward drag on the colon and the stomach. It frequently happens that the heavy, fæces-filled colon lies right at the bottom of the pelvis and, like an anchor, holds the stomach fixed in its subsided position. Furthermore, the stomach can drag down with it the lower part of the œsophagus, and then we encounter gastroptosis in its extreme form.

With maternal ptosis the aspect of the symptoms differs from that of virginal ptosis in this, that the stomachic attacks —cardialgia and vomiting—are far weaker, are often, indeed,

absent. It is due to the far more favorable conditions of space, as the stomach is not jammed or liable to be folded and bent as is the case with the virginal abdomen. For the same reason these patients do not generally suffer the innumerable pains and nervous sensations which characterize the others. That it is the distinction as regards space which causes the difference in the aspect of the disease is quite clearly perceived in the transition of a virginal ptosis to a maternal ptosis. So soon as the first confinement is overcome, a great improvement occurs in the condition of the patient so far as these symptoms are concerned.

With maternal ptosis, the constipation with all its consequences is the dominant feature in the aspect. In course of time the effect of the autointoxication from the intestine reveals itself. The patient grows emaciated and sallow, suffers from headache and, in addition, from an ever-increasing sensation of subsidence, and from the unpleasant, depressing feeling that something is subsiding in the abdomen, and from an oppressive sensation of and feeling of fatigue across the loins. The drag of the subsided stomach on the cardia and the œsophagus causes constant pain in the left side of the epigastrium and, not unfrequently, difficulty in the passing of the food through the œsophagus, so that a spasm of the cardia may arise—similar conditions sometimes occur with secondary dilatation of the œsophagus.

It is characteristic of the disease that all these symptoms improve or vanish entirely with confinement to bed, while they at once recur or become worse with an upright position.

The coprostasis may attain such stages that attacks resembling ileus may occur, and in extreme cases the stomach may also become so loose that volvulus ventriculi may occur.

II. Treatment.

When the surgeon has comprehended the correct nature of the disease, the question is whether the case lends itself to bandage-treatment or whether it demands an operative treatment.

As regards the indication for the employment of a bandage, this varies greatly with the two forms of ptosis which I have described. While the majority of the maternal ptosis patients may be helped sufficiently with a good and rational bandage, with virginal ptosis patients one only quite exceptionally obtains an effect worth mentioning. This simply lies in the fact that the virginal abdominal wall is so muscular, vigorous, and elastic that, to overcome its resistance, such a strong pressure would be necessary as would be unendurable to the patient. With maternal ptosis, on the other hand, we are able to obtain good results through the relaxed thin abdominal wall with a good bandage.

An effective and good belt must comply with three requirements: (1) The pressure must act widely over the hypogastrium by aid of a large and rather firm pelotte; (2) the pressure must be powerful and invariable; and (3) one must be able to adjust the belt in a recumbent position in the morning, before the patient rises and while the organs still lie in their right position. For this reason all bandages which fasten at the back with laces are banned.

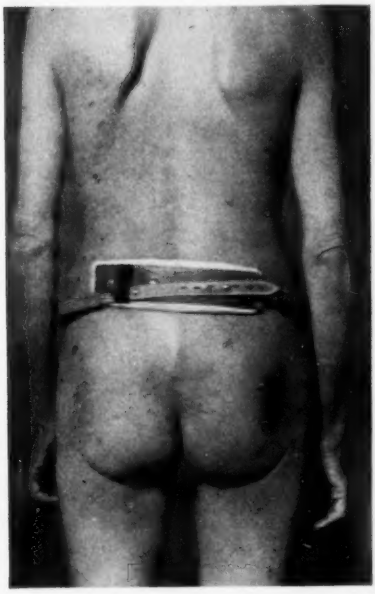
After many experiments I have returned to a copious, firmly stuffed pelotte, placed on a steel-spring belt in which, as with the English double hernial truss, the pressure is exercised by two spiral springs which are movably connected with the large abdominal pelotte in front, and at the back are supported against the sacrum or against the sacro-iliac symphysis by one or two small pelottes (Figs. 3 and 4). These springs can be made as powerful as one wishes, and relax but slowly and slightly, when they are easily tightened again. But even this powerful belt, which I recommend as the best, is impotent with most virginial ptoses, as also with those particularly severe cases of maternal ptosis where the transverse colon has subsided right down into the small pelvis, and is on that account beyond the range of the belt, being squeezed rather than raised by this.

In all these cases, then, the only help for the patient is an operative encroachment which will raise the stomach and

FIG. 3.

Curtis's abdominal support, front view.

FIG. 4.



Curtis's abdominal support from behind.

colon into their normal position. For the achievement of this object we are in the possession of various methods: (1) direct gastropexy as it has been for the first time performed, independently of each other and after different methods, by Dupet and by Rovsing, and (2) the indirect operations which endeavor to raise the stomach, either by basting together and shortening the omentum minus as proposed by Stengel, Bier, and Beyea, or from below as with Coffey's operation which, by stitching the omentum majus firmly to the anterior abdominal wall, raises the stomach and colon.

If one were to choose *a priori* between these methods, the indirect operations would at first seem the more attractive, because with these one avoids fixing by adhesions an organ which needs mobility for its activity. Apart from the fact that adhesions in the peritoneum are for various reasons generally considered objectionable, one would think that a broad soldering of the anterior surface of the stomach to the abdominal wall must cause a considerable reduction of the motility and result in retention of the food, and it was just these objections and reasonings which led Beyea and Coffey to prefer the indirect operations. As the thought was also pleasing to me, I tried both methods, but have had to abandon them in favor of direct gastropexy.

Firstly, as regards Beyea's operation—the shortening of the omentum minus—this is in a great number of cases, and especially so in the severe cases which demand operations, technically impossible; because the omentum minus either no longer exists, or is so thin (as thin as tissue paper) and perforated that there can be no question of placing sutures in it. But even in those cases where the operation is possible, one generally gains only a temporary improvement or cure, because the same forces which have lengthened and weakened the ligaments continue to act, and by degrees the ligaments will again give way and the stomach will subside.

Coffey's operation seems to be more rational and better devised, because in many cases the omentum majus is strong and well preserved, and because, owing to its being fastened

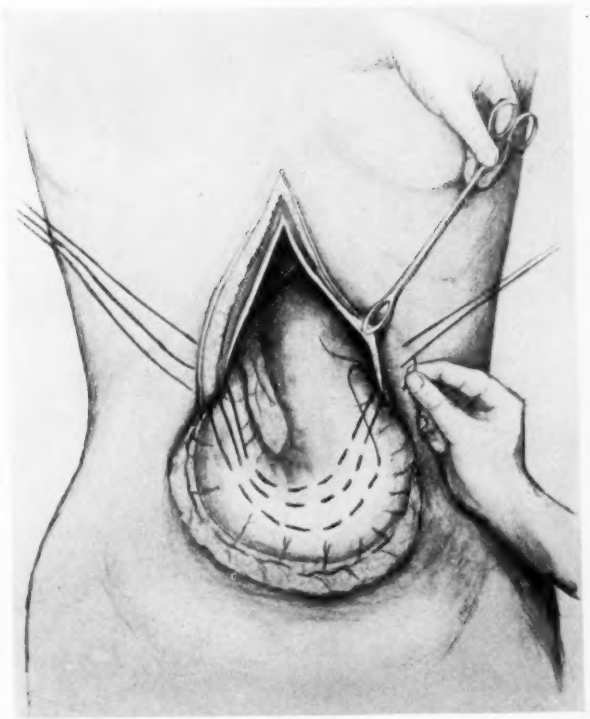
to the anterior abdominal wall, a raising of the greater curvature as well as of the transverse colon takes place and, in addition, a stretching of the mesocolon transversum on which the stomach normally rests. In Coffey's hands this operation seems also to have given fine results.

In the cases where I have attempted this operation, it has answered most satisfactorily during the period immediately following it, but in the course of a few months the patients have returned, suffering in part from the old symptoms and in part from new ones arising from omental adhesions (pains, constipation, diarrhœa). The reasons for this are: first, that the omentum can be fastened to the sides of the centre line only in an inferior degree, and that for this reason there is room for a subsidence of the fundus of the stomach in the left side, and then a bend between the free part and the fixed part easily occurs; second, that the omentum is very slack, and its adhesions therefore easily drawn out into long bands which present the danger of ileus.

Notwithstanding the theoretical attraction of the indirect operations, I must in accordance with my experience advise direct gastropexy as the safest and best method.

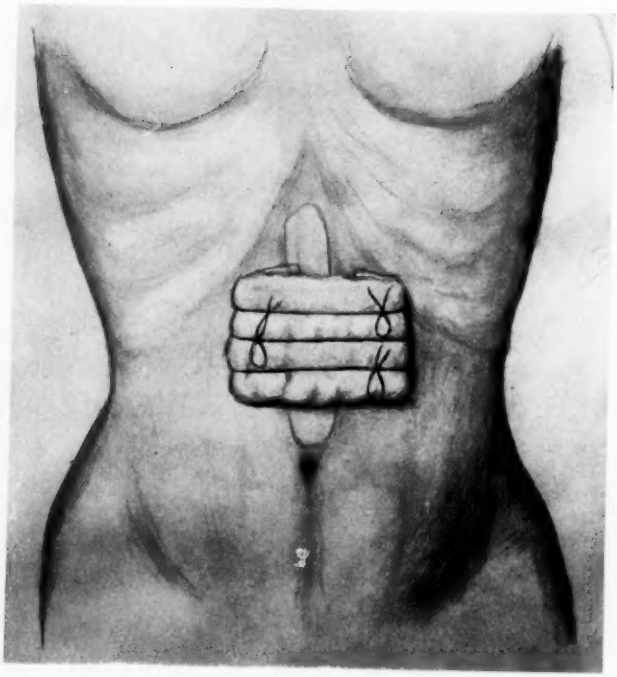
When, in 1897, I thought for the first time of performing gastropexy with a patient who was admitted with the diagnosis of cancer of the stomach, but who only showed gastroptosis pure and simple, it appeared from an inspection of the literature that such an operation had been performed once before by Duret, of Lille, in accordance with the method here portrayed: He made an incision through the skin and the muscles to the umbilicus from the ensiform process, but incised the peritoneum only in the lowest half of the wound, and then fixed the lesser curvature of the stomach to the untouched upper part of the parietal peritoneum with the aid of a single silk thread. This was led in and out alternately through the serosa of the stomach and the parietal peritoneum. The ends of the thread were conducted out through the recti muscles, and were tied subcutaneously over these. The method did not meet with my entire approval; first, because a single thin silk thread seemed to me too insecure a fastening, and

FIG. 5.



Author's method of gastropexy.

FIG. 6.



Author's method of gastropexy. The silk sutures are held over a glass plate.

in the next place because I found it precarious to fix the pylorus, which normally should lie deep down and be mobile, to the anterior abdominal wall, and finally because the tying of the silk threads in the centre line must inevitably involve a serious shrinkage and folding of the lesser curvature. In that first case I at once employed the method which I firmly recommend as being the best: Parallel with the lesser curvature I lead three strong silk threads in and out through the serous coating of the anterior surface of the stomach, leaving the pyloric portion free. The upper thread is placed close under the lesser curvature, and the two others, with an interval of about 2 cm., are placed in such a way that the greater curvature and a rather large piece of the wall above this are left free (Fig. 5). With a fine needle the serosa coating between the threads is now scarified in all directions, also the surface of the parietal peritoneum, and eventually that part of the under side of the liver to which one wishes the stomach to adhere. The ends of the silk threads are led out through the entire thickness of the abdominal wall, that on the left as far as the side of the rib-curvature, and that on the right at about 3 cm. to the right of the centre line. The peritoneum is now joined with catgut, and the fascia and skin with aluminum bronze, and, after the line of wound has been covered with collodion and cotton wool, the silk sutures are tied over a glass plate covered in sterile gauze (Fig. 6), the dimensions of which are a little larger than the stomach surface which has to be fixed. In this way it follows that the anterior surface of the stomach lies flat and close to the abdominal wall, without shrinkage and folding. These threads are left for four weeks and are then easily removed. A perfectly secure and solid adhesion is thus obtained.

After having employed this method with excellent results in 90 cases I allowed myself, in 1907, to be induced by Cannon's investigation as to the importance of the prepyloric part of the stomach with regard to the mechanical manipulation of food to modify my operation in such a way that I left the entire prepyloric part free, and only fixed the fundus with the aid of three silk threads, which passed transversely over the axis of the stomach and which were tied over a glass plate to the left of the centre line. With the systematic after-examination of all the cases treated with gastropexy up to January 1, 1911, the results from the latter method have proved to be far inferior to those of the

former, because while the former gave 60 complete cures in 94 cases, the latter gave only 29 cures in 69 cases. For this reason I have returned to the former method, and have employed it with my last 30 cases, the results so far being excellent.

Since 1897, when I performed my first gastropexy, till January 1, 1911, I have myself performed the operation 163 times, and have received information from other Scandinavian surgeons of 93 operations performed in accordance with my method. All these 256 patients have been traced and their condition since the operation carefully examined, with the following result:

ANALYSIS OF RESULTS OBTAINED IN 256 GASTROPEXIES.

		Per cent.
Complete cure	162	= 63.2
Great improvement	33	= 12.8
Improvement	18	= 7
Slight improvement or no change	32	= 12.8
Deaths	11	= 4.6

On separating my own statistics of 163 cases I get:

	Personal statistics. Per cent.	Statistics of Scandinavian surgeons. Per cent.
Cure	92 = 50.6	70 = 75.2
Great improvement	24 = 14.7	9 = 9.6
Improvement	18 = 11	
Slight improvement or none	21 = 12.8	11 = 11.8
Deaths	8 = 4.9	3 = 3.2
Total	163	93

First, as regards the mortality, it may well be said that a mortality of 4.6 per cent. is *per se* small. But on analyzing the cause of death in the individual cases the real mortality from gastropexy proves to be far smaller.

As concerns my own patients, two died a fairly long time after the operation from tuberculosis of the lungs, while four extremely exhausted patients died from bronchopneumonia during the week following the operation, but without any morbidity at all in the peritoneum.

On the other hand two died from ileus; the one from

a duodenoventricular ileus due to the strangulation of the duodenum over an old adhesion, the other from ileus of the small intestine due to an accidental strangulation of a coil of the bowels over an old adhesion due to an old hysteropexy.

As regards the three deaths mentioned in the statistics of the other Scandinavian surgeons, two of them had absolutely nothing to do with gastropexy as such: the one was due to a casual perforative appendicitis, the other to bleeding from a gastro-enterostomy performed simultaneously with gastropexy. In the third case, however, death must be ascribed to gastropexy, inasmuch as it was due to ileus of the stomach, the result of the hepatopexy having been neglected; the sunken liver then rode over the pyloric part of the fixed stomach.

The mortality with gastropexy proper is then 3 in 256 or 1.17 per cent.

As regards the recoveries, 71 or 75 per cent. of the patients were cured to the extent of being relieved of their pains, of regaining a healthy appearance and their strength, and, from being incapable, depressed, miserable wrecks, of becoming able-bodied, healthy, and happy people.

I wish to draw special attention to this, that *gastropexy in 76 of my 163 cases has freed the patients of their constipation of many years' standing, which had proved intractable to any other treatment.*

All these cases were equally severe, and some were more serious than those for which Arbuthnot Lane advised extirpation of the colon or ileosigmoideostomy: operations the dangers of which are extremely great as compared with those of gastropexy.

There then remain about 25 per cent. of the cases where the effect of the operation has not been satisfactory: in 11 per cent. the condition was improved considerably, but in 12.8 per cent. the improvement was quite insignificant or nil. As regards the cause of the bad results, an analysis of these cases warrants the hope that still better results may be attained in the future.

Here I shall first point to the circumstance that during a

period which comprises 73 cases, I employed, from fear of fixing the prepyloric portion, a method which a revision of the results has proved to be greatly inferior to my original method, inasmuch as the cures were 20 per cent. less in number. It is obvious that a future systematic carrying out of the original method of operation by a broad joining of the stomach to the abdominal wall will improve the results considerably. On other points, also, a change in the method of operation will effect improvement in the results.

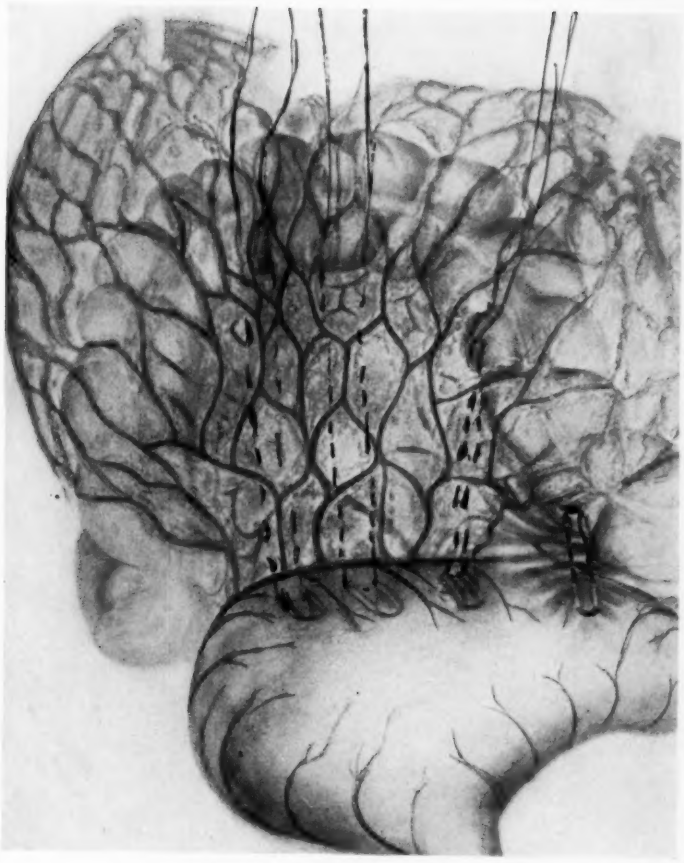
In all cases where the gastrocolic ligament is considerably elongated, one does not obtain by gastropexy pure and simple a lifting of the colon sufficient to remove the constipation.

In order to obtain this a special operation is required, and some of my less successful cases in earlier days are surely due to my non-appreciation of this and to later experiments with various inferior methods. Here, the right operation has proved to be the *shortening of the omentum and the mesocolon* by basting this with the aid of a row of thick catgut threads, which commence in the serous coating of the colon and end at the greater curvature (see Fig. 7). For me this has proved to be the ideal method as against the colopexy and the omentopexy to the anterior abdominal wall; because, while these restrict the mobility of the large intestine and in addition often cause adhesions, the shortening of the mesocolon and the omentum raises the intestine without restricting its mobility. The result seems to be permanent. A systematic employment of this little operation as an accessory to gastropexy in all cases with an elongated gastrocolic will increase the number of the entirely cured.

In some cases an imperfect diagnosis has been the cause of the bad result, as, for instance, the overlooking of an ulcer in the stomach or in the duodenum or of cancer in another organ. The improved diagnostic methods, and especially gastroduodenoscopy, will probably decrease the number of such mistakes in the future.

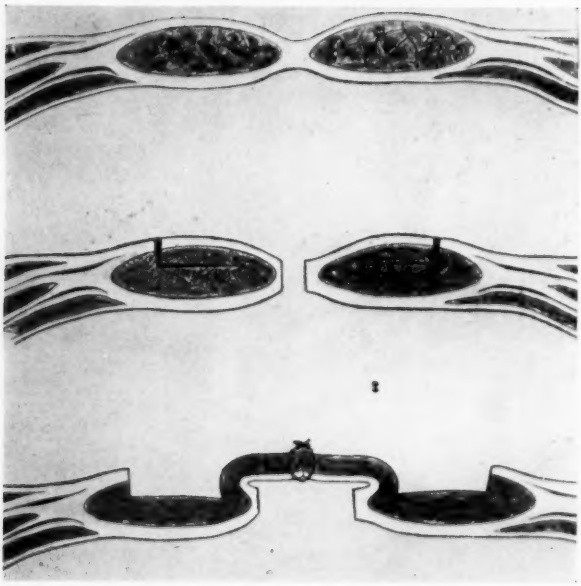
Finally there is a very important point which explains the difficulty of obtaining in many cases a complete cure for

FIG. 7.



Author's method of shortening the gastrocolic ligament.

FIG. 8.



Author's method to enlarge the abdominal wall in cases of virginal ptosis.

these patients, viz., the many consequences of enteroptosis and lacing which are co-ordinate with gastro- and coloptosis. First, the straitening of the lowest aperture of the thorax may be so considerable that there is no longer any room at all for the liver and the stomach, and therefore it is impossible to fix the stomach in a satisfactory manner without jamming it, just as it is impossible to get the colon sufficiently raised and to straighten out its folds and bends.

Even if the condition of the patient improves somewhat, the pains and the constipation in particular will nevertheless continue after the gastropexy.

Where the stomach is concerned, I think that one may obtain better conditions: partly by giving up any idea of its reposition, inasmuch as one fixes it lower down where there is room for it, and partly by making the abdominal cavity more capacious with a plastic enlargement of the abdominal wall. In no insignificant number of cases of gastroptosis one finds the space above the umbilicus so contracted that one has the greatest difficulty in inserting a finger between the vertebral column and musculi recti; if one fixes the stomach up here where it ought normally to lie it is jammed.

In such cases I have attained an excellent result by doubling the width of musculi recti in the following manner. Of the anterior blade of the rectus sheath and the anterior muscular layers I have formed rectangular lobes with their base at the medial edge, which lobes I have then joined in the centre line (Fig. 8).

If it is difficult in such cases—which always belong to the virginal type—to make room for the stomach, it is generally impossible to do so where the colon is concerned. Here the bends at the flexura become sharper and sharper, and become fixed by adhesions between the serosa surfaces at the angles. The constipation becomes more and more obstinate and invincible, and the autointoxication and pains render these patients utterly miserable.

Here, in this fortunately small group of cases, is, according to my experience, the real indication for Arbuthnot Lane's

" shortening " by ileosigmoidostomy, which I have employed with excellent result in two otherwise quite desperate cases. It was most interesting to notice how the abhorrence of food and the malaise of many years' standing of these patients were succeeded by a ravenous, almost immoderate appetite. With one of these patients the purgation showed a tendency to turn into diarrhœa, which, however, I was able to keep in check by dieting.

What still has great influence on the results of gastropexy is the ptosis of other abdominal organs, above all of the liver and the kidneys which is so frequently present.

That a considerable hepatoptosis prevents a good result from gastropexy is evident, because, when the patients get up after the operation, the liver falls and lies across the stomach and its supports, which may not only cause pains but may also cause ileus of the stomach, as was the case with one of the deaths reported by Hertel.

Therefore, with attendant hepatoptosis, hepatopexy should always be performed simultaneously with gastropexy. How frequently this is indicated is seen by my having had to perform hepatopexy in no less than 68 of my cases. I perform this in part directly with silk sutures which fasten the serosa covering on the convexity of the liver to the diaphragm, and in part indirectly with the aid of the ligamentum teres. This is severed after a double ligature, and the topmost end sewn to the diaphragm with strong silk thread, whereby the liver is raised up. It is of great importance that hepatopexy shall be performed very substantially with wide scarifications, in order that the heavy organ shall not tear itself loose again, and sink down on the stomach.

Sometimes the lacing involves the development of a large hypertrophied left lobe of the liver, which pushes against the curvature minor, and thus makes impossible the replacement of the stomach in its normal position.

In four cases I have been obliged to remove such a lobe of the liver by resection, in order to be able to perform gastropexy.

I perform the resection without loss of blood by simply pinching in two the liver tissue at the base of the lobe with Roux's angiotribe. Only the peritoneum holds, while the liver tissue bursts, and the vessels of the latter do not bleed. The large vessels are seen projecting from the surface and can easily be tied for the sake of safety. The peritoneum is then joined across the broken surface of the liver. If the peritoneum should burst or be insufficient for the covering of the surface of the wound, I transplant a piece of the omentum for the purpose.

In some few cases where pains and constipation remain after gastropexy, this is due to the prolapse of one or both kidneys, and the patients do not then recover entirely until after a nephropexy. With 10 of my cases it is not until after a unilateral or a bilateral nephropexy that I have succeeded in attaining an absolute result. A right-sided nephroptosis, especially, often involves a prolapse of the ascending colon and a pressure on the cæcum, thereby keeping up the constipation and pains.

In certain quarters there has arisen an inclination to maintain that the only operation which could be indicated with gastroptosis is gastro-enterostomy, because the vomitings and pains must be due to difficulty in the passing of food, "atony" and dilatation of the stomach. Now it is quite correct that, in a certain number—about 50–60 per cent.—of gastroptosis cases which require treatment, a slight delay in the emptying of the stomach occurs, so that this is completely emptied only after 5–6 hours. This delay is, however, by no means due to "atony," the muscular organs of the stomach really being in perfect order and prepared to act so soon as the stasis in the bowels, which is due to the constipation and to the ptosis bends on the large and small intestines, is removed.

Therefore gastro-enterostomy is never indicated with a simple gastroptosis, experience even showing indeed that it is a highly injurious operation, inasmuch as not only do the existing symptoms deteriorate greatly but an entirely new complex of symptoms also supervenes: nausea and gall-

vomitings. This is simply due to the fact that gastro-enterostomy does not at all strike at the cause of the stasis, which lies in the large intestine and far down in the small intestine at the opening into the cæcum, but, on the contrary, instead of removing the drag and the weight which the subsided stomach exercises, only increases this further, and a bend will very easily arise on the subsided folded coil of the anastomosis, which leads to a more or less pronounced circulus vitiosus.

Gastro-enterostomy, then, only increases greatly the sufferings of the ptosis patients, and even reduces them to a condition of extreme emaciation and misery. At one time or another I have had eight such patients under treatment. With four of these I have obtained a complete cure and with the other four a very great improvement by separating the intestine and the stomach at the point of the anastomosis, and, after having individually closed these, by performing gastropexy.

Therefore it is of extreme importance distinctly to diagnose between ulcus and gastroptosis. Because, excellent as the effect of gastro-enterostomy is with ulcus stenosis of the pylorus, just as injurious it is with a simple ptosis. Even if there is ulcus with ptosis without stricture of the pylorus, my advice, in accordance with my own sad experience, is entirely opposed to gastro-enterostomy. If the ulcer is small, and situated on a ptosis fold, one has to be content with a simple gastropexy, which then generally leads to the ulcer being healed. If the ulcer is large and infiltrating, it should be removed by excision.

I have chosen to discuss in this paper the pathological importance and treatment of gastrocoloptosis because, although it is extremely common the world over, and in spite of its turning a very large number of individuals, females in particular, into disabled, tortured, pitiable invalids, it is still greatly misunderstood and incorrectly treated.

It is of importance to surgeons to know that the disease is in a number of cases confounded with ulcus ventriculi and

cancer ventriculi, in order that they neither perform a useless, often injurious, gastro-enterostomy or close the incision, disappointed at not finding the anticipated ulcus or cancer, but perform the simple encroachment of gastropexy which alone can cure these patients.

It is of far greater importance to draw attention to the fact that the majority of these cases do not reach the surgeon, because the doctors, confounding cause with effect, enroll them under hysteria and neurasthenia, because they consider the stomachic and intestinal symptoms to be the outcome of a nervous, degenerative disposition; while, in reality, all the nervous symptoms are a result of ptosis and constipation. These patients wander in vain from doctor to doctor and from treatment to treatment, without finding relief. Small wonder that they become more and more nervous, and finally give one the impression of being above all neuropathic individuals.

If physicians the world over could have their eyes opened to the right diagnosis and treatment of these symptoms, an extraordinarily large number of suffering, disabled persons might regain health and strength by a bandage-treatment or by gastropexy, and the physicians would be relieved of the most ungrateful and wearisome patients.

A NEW PRINCIPLE IN ŒSOPHAGOSCOPY AND GASTROSCOPY.

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A VAST literature has accumulated on the subject of œsophagoscopy and an enormous amount of energy has been expended in the last two decades in the construction of new œsophagoscopes. In spite of these facts it must appear obvious to one who has investigated the matter that œsophagoscopy has as yet not received recognition as one of our safe and reliable diagnostic methods. There is no question that in a large proportion of œsophageal affections, as for instance strictures, neoplasms, foreign bodies, etc., a visual inspection is of the greatest advantage to the patient as far as the diagnosis and therapy are concerned. Let me remind you of the unexpected results that have followed the introduction of the cystoscope into urology. Is it not surprising that œsophagoscopy should have been so slighted by comparison, notwithstanding the fact that there has been no lack of effort in this direction and that the first attempts to inspect the œsophagus date as far back as those to inspect the bladder?

We can only explain this disproportion by the fact that as yet it has been impossible to construct an œsophagoscope that can be used with the same safety and reliability as the cystoscope. It is not that there is no demand for such an instrument. At first many were disposed to reject the cystoscope, and yet after a short time cystoscopy was generally adopted.

The great number of instruments heretofore constructed fall into two distinct groups: (1) straight tubes, which are introduced with the head in hyperextension; (2) jointed tubes, which are only straightened after their introduction into the

œsophagus. For the sake of brevity I shall only refer here to the two main types of œsophagoscopes that have been used up to date. Whoever wishes more detailed information is referred to the exhaustive historical review of the subject in Starck's "Die direkte Besichtigung der Speiseroehre. Œsophagoscopie," Würzburg, 1905.

The main exponent of the straight tube was v. Mikulicz, who began his researches as long as thirty years ago. The construction of these tubes is extremely simple, irrespective of whether the light is thrown in from without (v. Mikulicz), or whether the illumination is placed at the distal end of the tube (Jackson). Obviously, difficulties in construction cannot be held responsible for the fact that these instruments are not in general use. As an example that these instruments, in spite of their simplicity, are still unpopular, let me call your attention to the fact that the large majority of surgeons even to-day prefer to remove a foreign body by means of an external œsophagotomy instead of via the œsophagoscope. This proves rather conclusively that the introduction of these instruments is associated with the greatest discomfort, nay even danger, to the patient. The instruments of this type do not take into consideration the normal rectangular formation existing between the oral cavity and the œsophagus, which is only partly obliterated by hyperextension of the head. The introduction is frequently very difficult even when the teeth are missing, and when they are well preserved it is often impossible. Thus, some authors even go so far as to recommend the extraction of one or more teeth to make the introduction possible! I, personally, had the opportunity of examining an œsophagoscope which had been introduced by one of my colleagues and which distinctly showed the dental impressions in the hard steel. It is small wonder that patients will not tolerate such discomforts —to put it mildly.

So much for the discomforts. What, then, are the dangers of the straight tubes? It is well known that their use has been followed by a large proportion of perforations of the œsophagus, which resulted fatally. One of the reasons for this is that

the tube cannot be inserted in the longitudinal axis of the œsophagus even if the head is in extreme extension. There always exists a more or less obtuse angle between the tube and the œsophagus, and thus it is easily possible, especially when a certain amount of force is used, to crush the œsophagus against the spinal column and perforate it (Fig. 1).

The same danger exists with the second type, the jointed tube. This tube is constructed of a number of hinged joints, which after their introduction either snap into place automatically, or by means of a wire are pulled straight. In spite of the fact that it is not necessary to hyperextend the head with this instrument, its introduction is by no means easy and devoid of danger. Here also an angle is formed between instrument and œsophagus which makes its introduction difficult. Another difficulty is offered, which the accompanying diagram (Fig. 2) clearly illustrates. When one tries to introduce the instrument into the deeper parts of the œsophagus, one meets with considerable difficulty as soon as the instrument strikes the posterior wall of that organ and impinges on the spinal column. The instrument will no longer glide downward in direction of the arrow *c*, but points *a* and *b* will simply be approximated and the curve of the instrument increased, while the instrument sticks fast. These are not merely theoretical considerations, for in the beginning of my studies I experimented for several months with various tubes which I constructed upon this principle.

On the basis of these observations and experiences we must conclude that a satisfactory œsophagoscope must fulfil the following three main requirements:

1. The introduction must be possible in the normal position of the head.

2. The instrument must be so constructed that it actually passes in the longitudinal axis of the œsophagus and not at an angle to this axis.

3. The œsophagoscope should only be passed downward along the œsophagus under guidance of the eye to avoid perforations.

FIG. 1.

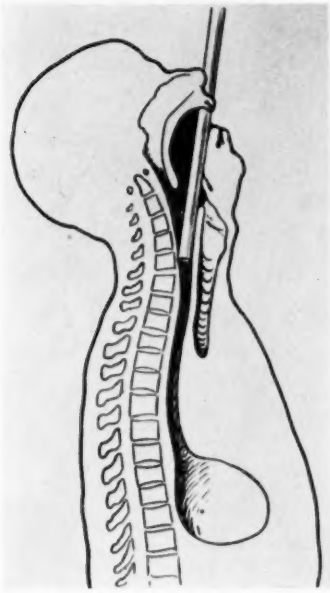


Diagram showing disadvantages and dangers of the straight tube.

FIG. 2.

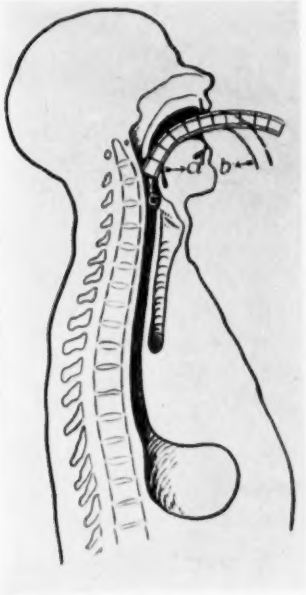
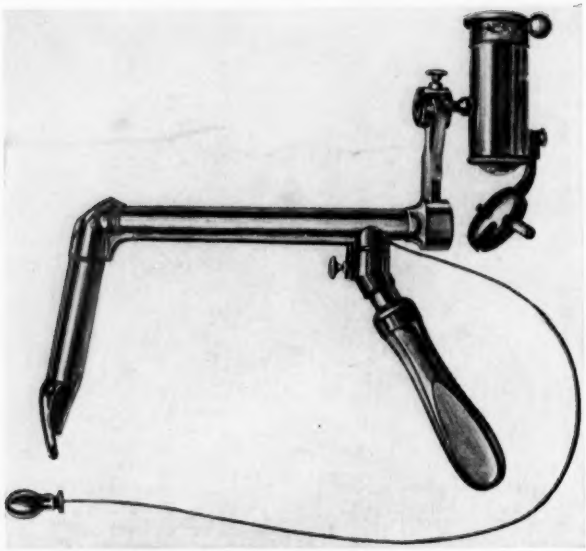


Diagram showing difficulty in introducing jointed tube.

FIG. 3.

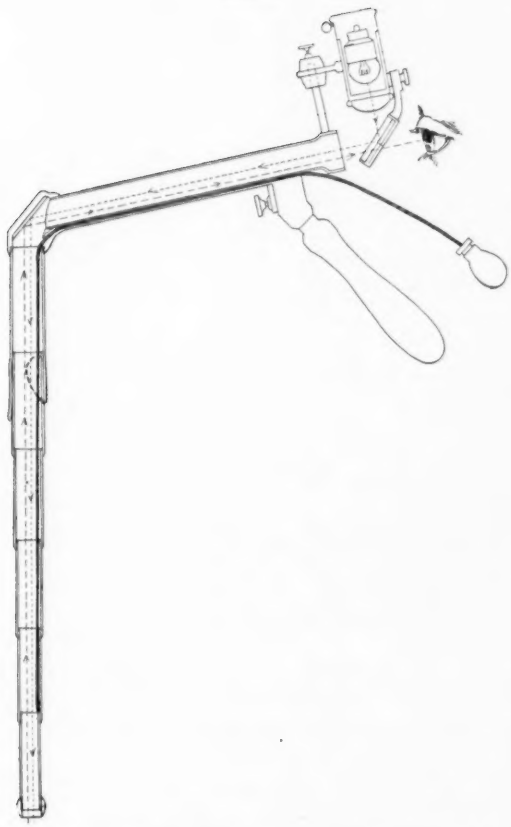


Rectangular telescopic œsophagoscope (telescope closed).

FIG. 4.

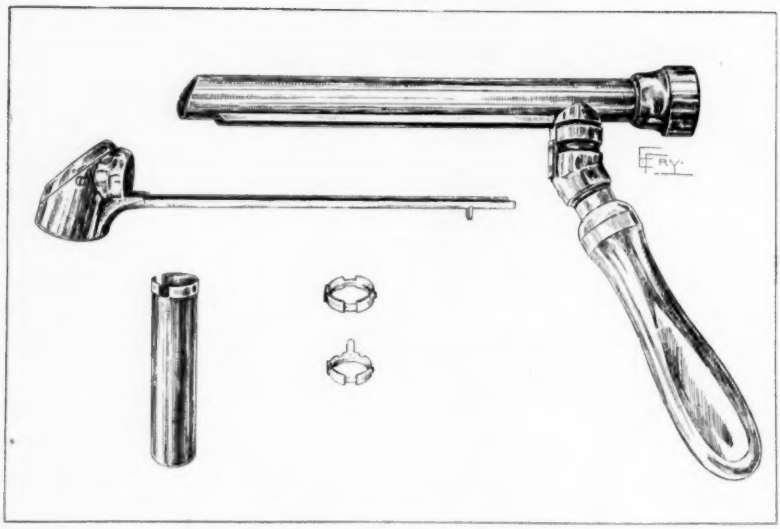
Rectangular telescopic œsophagoscope (telescope opened).

FIG. 5.



Diagrammatic sketch of the œsophagoscope, showing the directions of the rays of light.

FIG. 6.

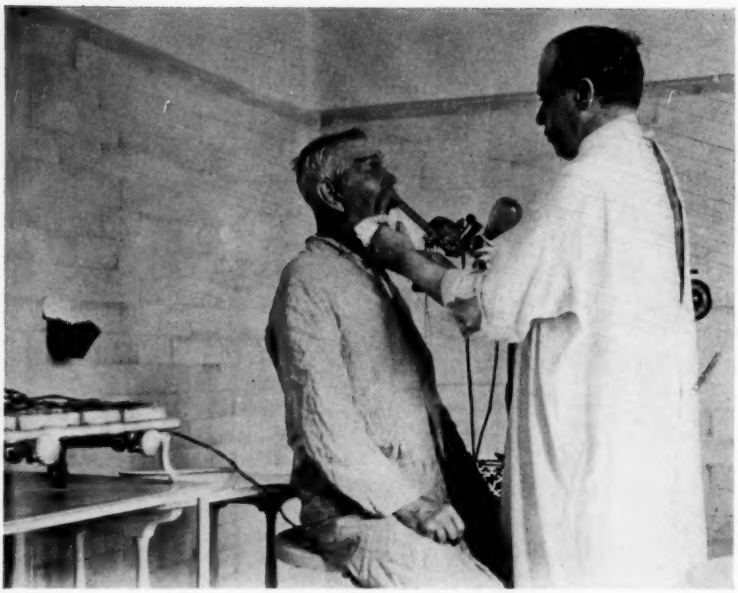


Sketch of separate parts of the œsophagoscope.

FIG. 7.

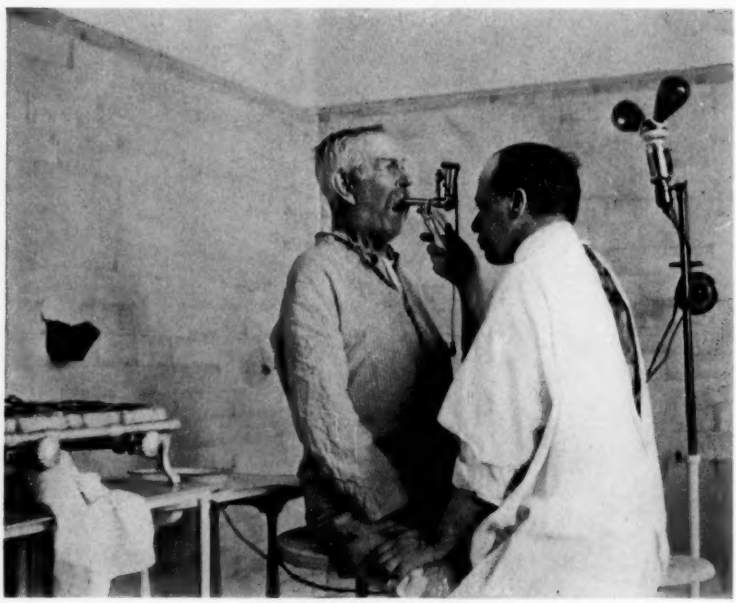
Sketch of œsophagoscope with aspirator in place.

FIG. 8.



Introduction of œsophagoscope (first stage).

FIG. 9.



Œsophagoscope in position.

FIG. 10.

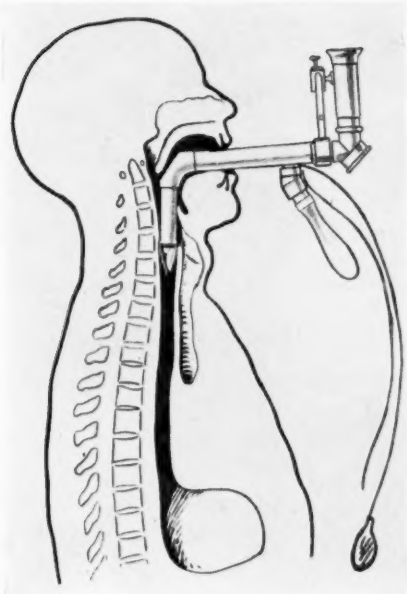


Diagram showing œsophagoscope in position with telescope closed.

FIG. 11.

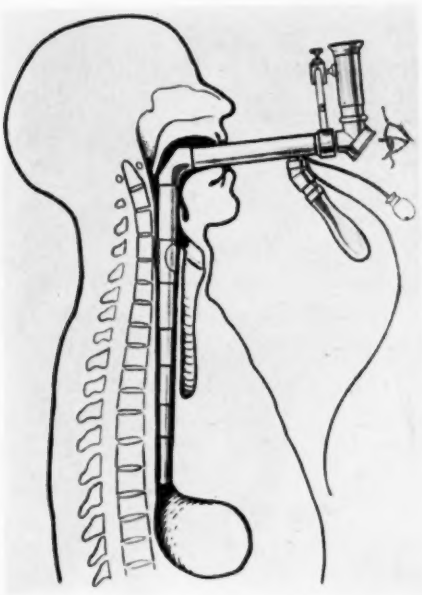


Diagram showing œsophagoscope in position with telescope opened.

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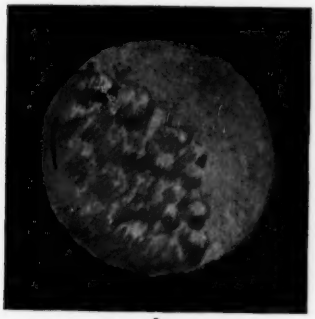

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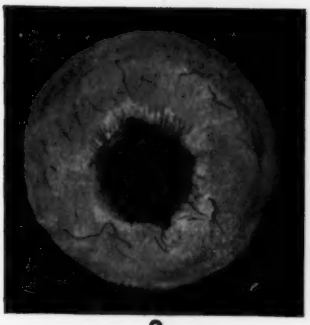

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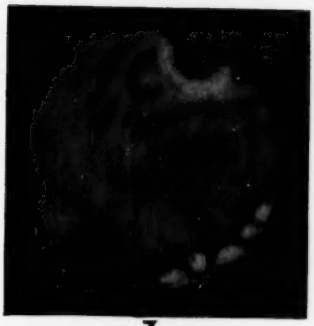

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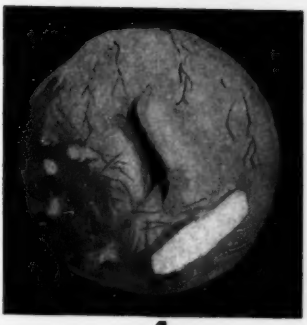

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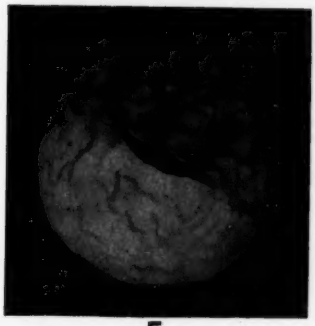

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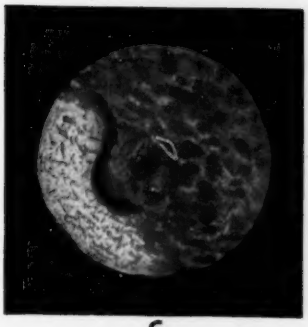

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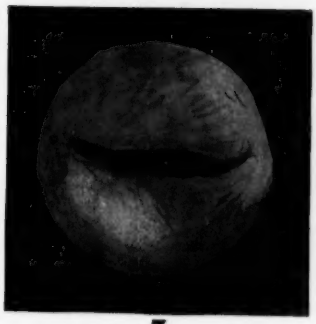

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Based upon these three main considerations I have constructed an instrument in the following manner:

The instrument consists of two portions which are joined together at almost a right angle; first, the horizontal portion which lies in the mouth of the patient during the examination, and second, the vertical portion consisting of a telescope composed of six separate tubes which may be pushed down into the œsophagus as far as necessary (Figs. 3 and 4). The horizontal portion consists of two parts which are represented in Fig. 6. These two parts can easily be separated by traction in a horizontal direction. These two parts each carry a semicylindrical canal. When the two parts are combined, the canals form a tube. In this tube the spring, which is necessary for the manipulation of the telescope, rests. In this way this spring lies entirely outside of the main horizontal tube and does not disturb in any way the passage of the light rays.

At the proximal end of the horizontal tube, which, of course, lies outside of the mouth, is attached the illuminating apparatus. This consists of a lamp and condenser (Fig. 5). I use a Tungsten lamp containing three crossed filaments. This lamp is copied from the one constructed by Fischer of Freiburg, but it gives a much more intense light. An exceptionally strong source of light is necessary for my instrument, because, as can be seen from Fig. 5, the light is broken three times before it reaches the eye of the observer. Naturally, therefore, much more light is lost than with the straight œsophagoscope where the ray is not interrupted at all or, at most, once. The street current is adopted for the light by means of a rheostat. Inasmuch as the lamp is well insulated, one need not fear a short circuit. Directly under the lamp a condenser is placed which concentrates the rays. The rays then fall on a mirror (Figs. 3 and 5) which is movable on a horizontal axis. From this mirror they are thrown to a second mirror which lies at the junction of the horizontal and vertical portions of the instrument. This second mirror interrupts the rays in such a fashion that they fall directly downward in the telescope. The return of the rays to the eye of the observer is clearly shown in Fig. 5. The picture is inverted but not reversed.

I use the thinnest possible quartz mirror. As a result of the thinness, the loss of light on account of penetration of the glass is minimal and a quartz mirror polarizes light much less than the ordinary mirror, which fact also adds to the brilliancy of the light. The distal mirror is easily removable, so that it can be cleaned. The vertical part of the telescope is attached by means of a thread to the horizontal portion. To separate the telescope from the horizontal part of the instrument, it is first necessary to unscrew the olive at the end of the spring and to detach the screw lock that holds the two separate portions of the horizontal part together. The horizontal tube is then pulled out (Fig. 6) and the carrier of the distal mirror is then unscrewed from the telescope by means of a key. The part holding this mirror is then lifted off and nothing but the telescope with the spring attached remains.

In describing the telescope which is the essential novelty of this instrument, I wish to limit myself to the main points in its construction. It would be impossible to go into all the details of construction, as it would make the description too complicated. The telescope consists of six steel tubes, the walls of which are 0.8 mm. thick. At the upper and lower end of each tube is an attachment, of which the upper is shown in Fig. 6. The inner attachment protrudes into the lumen of the tube and forms a ridge, on which the next tube catches, when the telescope is open.

As can be seen in Fig. 6, the upper attachment of the tube is more than a simple ridge and is so constructed that a ring can be inserted into it. The rings serve the same purpose as the cylinder under the horizontal tube, namely, to keep the spring entirely out of the field of vision. They can be easily inserted into the upper part of each tube and just as easily removed with a small lever. On the outer part of each ring (Fig. 6) is a small plate and a button which fit into corresponding openings in the attachment to the tube and which keep the rings in place. On the posterior part of the ring (shown anteriorly in Fig. 6) is a groove which permits the spring to pass between the ring and the telescope.

Opposite this groove for the long spring is a small spring attached to three of the six rings. This small spring glides along the inner wall of the telescope when it is opened, and when the telescope is closed fits into a small groove in the ring just above and is thus buried. Although these little springs seem quite insignificant, they are of the greatest importance for the proper functioning of the telescope. The long spring (Fig. 5) has a tendency to produce a slight curvature of the telescope with the concavity toward the observer. That the telescope may work surely, especially for its withdrawal, it is essential that it is perfectly straight. This is the function of these short springs, namely, to counteract the tendency toward curvature produced by the long spring and to insure an absolutely straight telescope.

The distal end of the spring is soldered with silver to the upper edge of the lowest tube. At the lower end of the innermost tube is a metal ring which can be unscrewed and which opens the lumen of the œsophagus when the telescope is pushed down. This ring also facilitates the downward passage of the telescope. Attached to the lower part of the upper tube are two metal guides (Fig. 3). These guides are not only attached to this tube, but the tube and guides are made of one piece of metal. I shall later refer to the importance of these guides for the introduction of the œsophagoscope. These guides greatly facilitate the introduction of the instrument and since I have used them I have never had the slightest difficulty in introducing the œsophagoscope, with the exception of one instance, where pathological changes were responsible. The length of the telescope is now 33 cm. If one adds 10 to 12 cm. as the distance from the posterior pharyngeal wall to the teeth, then the total distance from the teeth to the end of the instrument is 45 cm., which is quite sufficient to inspect the entire œsophagus down to the cardia. The diameter of the six tubes of the telescope varies from 12 mm. (lowest tube) to 17 mm. (uppermost tube). It would be easily possible to add another tube

above with a diameter of 18 mm. There is sufficient room in the œsophagus to do this. This would add another 5 cm. to the telescope and it would be possible in a suitable case to even pass the instrument into the stomach and thus to attempt a direct gastroscopy. From its point of emergence from the horizontal portion of the instrument (Fig. 3) the spring is marked at intervals of 5 cm., so that one can easily tell how far the telescope has been passed into the œsophagus.

In order to clean the telescope, I advise its complete separation into its individual portions, a thorough cleansing of each part with benzine, sterilization by boiling, and lubricating with vaseline before reassembling the parts.

Without going too much into detail I might mention here that it is possible in examining high lesions in the œsophagus that one may not need to use all six tubes. One might reduce the thickness of the instrument and at the same time increase the field of vision, if one had three sets of tubes to be used according to the height of the lesion. The following combinations would be practicable: 1, tubes 1–6 inclusive; 2, tubes 2–5 inclusive; 3, tubes 3 and 4.

On account of the right angular construction of the instrument and the rings which protrude into its lumen, it became necessary to construct an aspirator which differed somewhat from the one in ordinary use (Fig. 7). The rubber tube is carried over the right angle by means of a spring resembling the Albarran finger of the cystoscope which is attached to a metal tube through which the rubber tube is passed. That the rubber tube does not catch on the rings, a small perforated metal button is attached to its distal end. The outer end of the rubber tube is attached to an aspirating bottle. With this instrument the aspiration of mucus is as easy and certain as with the straight tube.

I shall not say much here about the forceps which I am now constructing. Certain changes are necessary for it to compete in usefulness with the forceps that is used with the straight tube. I am convinced from my previous experiments in this direction that this problem will soon be solved. I hope to be able to present this forceps in a later publication, and also to describe a bougie that can be used with my instrument.

The method of examining the patient with my new instrument is as follows: The patient sits on a chair, the head being supported by an assistant. The pharynx is anæsthetized with a 10 per cent. or 20 per cent. solution of cocaine. The introduction of the œsophagoscope is accomplished in two stages:

1. *The "anchoring" of the instrument in the œsophagus:* The examiner stands in front of the patient, and while he draws the tongue out lightly with the left hand, pushes the instrument with the right hand to the posterior wall of the pharynx (Fig. 8), keeping the instrument exactly in the

middle line of the head. When the distal extremity of the instrument touches the posterior pharyngeal wall, the handle must be gently elevated, until the ocular comes into a horizontal plane. In this way the instrument glides automatically over the epiglottis and arytenoid cartilages, and the two metal guides at the distal end of the upper segment of the telescopic tube anchor themselves in what Killian has termed the " mouth of the œsophagus." If the spring is then pushed forward a few centimetres, the metal guides are separated and the œsophagus opened, the innermost of the six telescopic tubes passing the guides and exposing the œsophagus to the visual field.

2. *The passage of the œsophagoscope into the deeper parts of the œsophagus:*

Although the anchoring of the instrument in the mouth of the œsophagus is performed blindly, this second stage of the process must only be undertaken under the guidance of the eye. The examiner seats himself on a chair in front of the patient and then pushes down the spring (Fig. 9), while watching the descent, as the patient swallows.[2] It is essential that the lumen of the œsophagus is always kept in the field of vision. Usually this is easily accomplished. Should it vanish or become too excentric, it can be easily brought into view by gently lifting or dropping the handle of the instrument. When the examination is finished, the spring is gently pulled until the telescope is again closed (Figs. 10 and 11). The instrument is then withdrawn by dropping the handle and lifting the closed telescope out of the mouth.

The advantages of this right-angular telescope, as compared with the straight tube, are very marked. It is immaterial whether the patient has an easily movable cervical spine or a full set of teeth or not. The patient is not brought into any strained position, and the head is held in a natural way during the entire examination. The finding of the entrance of the œsophagus, which is often exceedingly difficult for the inexperienced beginner, occurs here blindly and automatically. The two metal guides act as an obturator or a sound, and lead the way for the instrument. The opening of the telescope is

so simple, because this instrument is the first that can really be pushed down in the longitudinal axis of the œsophagus and not an angle to this axis. The ease with which the examination is possible was well demonstrated in Case IX. In looking for an incipient cancer of the œsophagus, I pushed the telescope down at least a half-dozen times, and thoroughly inspected the entire organ until I was certain that there were no pathological changes in the mucous membrane.

I trust that I shall not be misunderstood. Œsophagoscopy will always be, for the majority of patients, a rather disagreeable procedure. The introduction of even a soft stomach tube causes many patients to press and gag. Judging, however, from my experiences and those of many of my colleagues, who were present at my examinations, there is no comparison in the disagreeableness caused by the use of the new instrument to the extreme discomfort to the patient produced by straight-tube œsophagoscopy. I think I have succeeded in constructing a useful œsophagoscope, which answers those requirements that in the beginning of my paper I showed were demanded by such an instrument. To be sure, it has long since been proven that it is possible to inspect the œsophagus by means of a straight tube. That, however, this is the ideal method, which it has been claimed to be by many authors, and that it would not be worth while trying to improve upon this method, has never been my conviction. I think that the unpopularity of the straight-tube method proves that I am right.

I wish now to briefly consider another question. Is there really an actual demand for a useful œsophagoscope? Is there, for example, any necessity for the use of this instrument in the diagnosis of the most common affection of the œsophagus, *i.e.*, carcinoma? It has often been claimed that it is possible to make a certain diagnosis of œsophageal cancer merely from the clinical data without direct inspection. That may be true to a certain extent in the advanced cases with obstructive symptoms, and it is for this reason, namely, that the diagnosis can only be made when the disease has reached an advanced stage, that the attempted radical surgical treatment of this

disease has been so unsuccessful. The symptoms of this disease do not develop over night, and the symptoms of stenosis are merely the last link in the chain of clinical phenomena, which began often many months before. Frequently the patient will state that he was entirely well up to one or two weeks ago. If one goes into the history more carefully, however, one finds that the patient had burning pains in the chest, feelings of oppression, defective appetite, etc., all symptoms which usually began several months before. If we are to accomplish anything in the radical excision of œsophageal cancer, the only time to attack this disease by surgical measures is in the very earliest beginning. For this reason we do need an instrument that is not feared by physician and patient alike. The only possibility of making an early diagnosis of cancer of the œsophagus is offered by direct inspection with possibly a subsequent probatory excision. Even the X-ray is entirely ineffective in these incipient cases.

Œsophagoscopy is often of the greatest importance from the stand-point of differential diagnosis. As was shown in Case V, we were able to differentiate the dysphagic symptoms of a mediastinal tumor from a possible carcinoma of the œsophagus. In Case IX the clinical symptoms suggested a cancer of the œsophagus, but the negative œsophagoscopic findings removed this suspicion, and an exploratory laparotomy disclosed an extensive ulcer of the stomach.

I do not believe that the claim that the rarity of œsophageal affections does not warrant the expenditure of so much time and effort in the construction of a new instrument is tenable. I am convinced that œsophageal disease is by no means infrequent, and when our diagnostic methods have reached a greater state of perfection it will be seen that the lesions of the œsophagus are proportionately of common occurrence.

I would like here to answer an argument that might be advanced against the complexity in the construction of the instrument. There is no question that this new œsophagoscope is decidedly more complicated than the straight tube

that has been used hitherto. When one thoroughly understands the instrument, however, it works with as great a certainty as the straight tube, and if properly handled does not get out of order. I have examined several dozen cases with the same instrument, and it functionates just as well to-day as it did in the beginning. The instrument may be somewhat complicated, but at any rate its construction has been adapted to the patient and not *vice versa*. There is little doubt in my mind as to what choice the patient would make if both models were laid before him. It is immaterial to the patient whether the instrument is complicated or not. The important point is the possibility of a comfortable and certain examination.

A summary of my clinical results is herewith appended.

CASE I.—J. P., male, sixty-two years. (German Hospital, Dr. Kammerer.) Three months ago pain in stomach. This left him, and two months ago he began to have pain low down in the throat and difficulty in swallowing, being able to swallow fluids only. Has lost about 10 pounds during past 6–8 weeks. Never expectorated blood. Never noticed blood in stools. Status: negative, excepting œsophageal obstruction 10 inches from teeth.

March 6, 1912: Gastrostomy (Dr. Kammerer).

April 10, 1912: Œsophagoscopy: ten inches from teeth the œsophagus lumen is obstructed by a cauliflower-like tumor, which occupies about two-thirds of the picture. The tumor's color is dark red, with some yellow spots on it. The other one-third of the lumen, *i.e.*, the part not occupied by the tumor, shows a silver-like color, very distinct from the dark red tumor (colored plate, Fig. 1).

Diagnosis: Proliferating carcinoma of the œsophagus, ten inches from teeth.

CASE II.—R. M., male, forty-eight years. (Mount Sinai Hospital, Dr. Brill.) Previous history negative. Present illness: since three months burning sensation in swallowing beneath sternum and increasing difficulty in swallowing. No vomiting, no regurgitation. Has lost in weight. Status: large axillary glands. Many râles all over chest. Test meal: nothing obtained; tube arrested at 11 inches, followed by some bleeding.

Œsophagoscopy May 1, 1912. Passage into the upper part of the œsophagus easily accomplished. The instrument passes down to 11 inches from the teeth, where it stops on account of obstruction. Œsophagus lumen at this point very narrow. No large proliferating tumor is seen, but a great number of grayish nodules, especially at the posterior wall of the œsophagus (colored plate, Figs. 2 and 3).

Diagnosis: Infiltrating carcinoma of the œsophagus at a distance of 11 inches from the teeth.

Case III.—S. G., male, fifty-four years. (Mount Sinai Hospital.) Began six months ago with difficulty in swallowing solid food and sensation of pressure and fulness beneath sternum. Epigastric distress after meals. Four months ago discontinued swallowing all solid food on account of gradually increasing difficulty. Lost considerable weight and strength. Forced to vomit often after eating, owing to distress. No blood in vomitus. Stools negative. X-ray shows some dilatation of œsophagus. Bougie goes down to 18 inches (curling up in dilated œsophagus?).

Œsophagoscopy, May 10, 1912: The telescope is pushed all the way down into the œsophagus, but no pathological condition was seen. On the basis of these negatives I differed with the diagnosis made (carcinoma of the œsophagus) and said that we are dealing with a carcinoma of the stomach growing up toward the cardia. On the operating table (second service, Dr. Lilienthal, May 10, 1912) this was verified. A big tumor of the stomach was found, occupying the posterior wall of the stomach and part of the smaller and larger curvatures, going upward in the direction of the cardia, the cardiac end of the œsophagus being smooth and not infiltrated by the carcinoma.

Case IV.—S. M., male, sixty-four years. (Mount Sinai Hospital Dispensary, Dr. Emil Mayer.) Eight weeks ago pain and burning sensation in swallowing. Can swallow fluids only. Loss of weight and strength. Bougie finds obstruction 6 inches from teeth. Œsophagoscopy May 22, 1912. After extending the telescope to its full length (cardia) a markedly congested area is seen on the left side, covered with whitish nodules, numbering about six. The œsophagus lumen, which was perfectly round in the upper parts of the œsophagus, appears here as a slit with protruding walls. A whitish mass is seen on the right side of the

picture, probably some curdled milk or washed-out food particle. (With forceps this piece could have been removed for examination.)

Diagnosis: Infiltrating carcinoma of cardia (colored plate, Fig. 4).

CASE V.—B. S., female, fifty-one years. (Mount Sinai Hospital Dispensary, Dr. Aronson.) Four months ago substernal pains and difficulty in swallowing solid substances. Attempt to take solid food accompanied by feeling of pressure beneath the middle of the sternum, the food being immediately regurgitated. Noted blood only once. Obstruction seems to have become more marked during the past two weeks, and now patient experiences difficulty even in swallowing semi-solids and fluids. Has lost considerable weight.

Dull area over lumbar interscapular region, with diminished breathing. Œsophagoscopy: The telescope can be pushed down to the cardia without finding an obstruction. The mucous membrane of the œsophagus appears to be perfectly normal. The tumor is evidently extra- and periœsophageal, not intra-œsophageal.

CASE VI.—L. S., male, forty-five years. (German Hospital, Dr. Willy Meyer.) About three months ago horse stepped on his abdomen (upper portion). Did not vomit blood then or since. Pain after accident continued in lower portion of sternum. This pain is increased by motion and by lying long in one position; is not made worse by deep inspiration. One month after accident patient began to hiccough after eating, then vomited immediately after meal; since one month cannot take solid food without vomiting immediately. No vomiting, if he swallows small amounts at a time; frequent belching of gases. General examination negative. Bougie passes into stomach; no obstruction evident at cardia.

Œsophagoscopy June 21, 1912: Very easy introduction of instrument. No obstruction is found in pushing the instrument down to the cardia. The cardia is seen as a small horizontal slot; the posterior wall seems to be somewhat more protruding than the anterior wall. No ulcer seen. No hemorrhage. The illumination of the field was good, though not entirely satisfactory. Operated July 22, 1912, by Dr. Rehling. Carcinoma of the stomach, occupying more than two-thirds of the stomach. Gastrostomy.

CASE VII.—A. K., male. (German Hospital, Dr. Willy Meyer.) Since one year pain and difficulty in swallowing; during the past three months nothing but fluids passed. Bougie blocked at 16 inches.

Œsophagoscopy June 22, 1912: Cocainization of pharynx. Easy introduction of instrument. The telescope is pushed down to about one and one-half inches above cardia, where an obstruction of the lumen is present. The small but clear field of vision shows two very distinctly different aspects of the mucous membrane of the œsophagus. The lower part (anterior wall) is whitish in color (normal œsophageal mucosa), whereas the upper part (posterior wall) shows a dark-red coloration with numerous very small nodules on the surface. The appearance of the area resembles very much the irregular surface of a strawberry (C. p., Fig. 5).

Diagnosis: Carcinoma of the cardia.

Operation (June 24, 1912) (Dr. Willy Meyer).—Extensive involvement of cardiac end of stomach by carcinomatous growth. Gastrostomy.

CASE VIII.—F. C., male, sixty-seven years. (German Hospital, Dr. Willy Meyer.) Since ten weeks feels that food sticks in his throat. Vomited some mucus, no food. Never any blood. Loss of weight 20 pounds. Bougies can only be passed 20 cm. down from teeth.

Gastrostomy: June 10, 1912.

Œsophagoscopy: June 25, 1912. Cocainization of pharynx. The telescope can be pushed down to a distance of 10 cm. above the cardia. At this point the opening is seen as a small slot. At the left side of this slot the normal œsophageal mucosa appears of whitish color and markedly corrugated. The right side of the slot, which is situated somewhat eccentrically, is very much indurated, and shows a few prominent grayish nodules adjoining the border of the œsophagus lumen. More laterally the œsophagus mucous membrane is markedly congested, quite different in appearance from the left side (C. p., Fig. 6).

Diagnosis: Carcinoma of the œsophagus behind the aortic arch. The patient stood the examination extremely well, so that the instrument could be left in place for twenty minutes (in order to show the picture to a number of colleagues) without causing any discomfort.

CASE IX.—G. S., sixty-five years. (German Hospital, Dr. Willy Meyer.) Two months ago began to have sensation at lower end of sternum as if his food stuck. This gradually got worse. Has never vomited, but feels nauseated.

The bougie found some obstruction 8 inches from teeth, but after passing this distance could be pushed all the way down into the stomach. Œsophagoscopy: June 29, 1912. Telescope pushed down under guidance of eye without encountering any obstruction. Mucosa appears perfectly normal on repeated inspection by moving the end of the instrument up and down the whole length of the œsophagus.

Epicrisis: Based on the œsophagoscopic inspection, the suspicion of a beginning carcinoma behind the cricoid could not be entertained. We then came to the conclusion that he was suffering from a gastric and not from an œsophageal disease.

Laparotomy (Dr. Willy Meyer, June 28, 1912) showed a circular ulcer of the stomach (hour-glass stomach), not involving the cardia.

Gastro-gastrostomy was done.

CASE X.—S. B., female, fifty-four years. (Mount Sinai Hospital.) Substernal pain for the last nine months after ingestion of food. Feeling of obstruction. Vomited for four months right after taking food, occasionally bloody. Lost about 30 pounds in weight. Obstruction found 10½ inches from teeth. Tumor bleeds very easily. Œsophagoscopy: July 11, 1912. The upper part of the œsophagus shows a normal mucous membrane and long horizontal slit (C. p., Fig. 7). In pushing down the tube to 10 inches, the opening appears very narrow; the whole surrounding mucosa shows a dark-red coloration. Around the lumen, which is of very irregular outlines, nodular masses are seen, which protrude into the œsophagus lumen (C. p., Fig. 8).

Diagnosis: Carcinoma of the œsophagus 10 inches from teeth. Gastrostomy.

Before concluding my paper, I desire to say a few words in regard to the experiments I have made in attempting to apply the telescopic principle to a gastroscope. These experiments extended over a period of two years, but were abandoned during my experimentation with the œsophagoscope. The optical part of this gastroscope is turned in the stomach by

means of a bevel-gearing, applied for the first time in this connection by Eckstein. With this instrument I have been able to inspect the wall of the stomach in a few cases, but, not having had any tangible clinical results as yet, I prefer to postpone a detailed description of the instrument to some later date.

In conclusion I wish to thank Dr. Heinrich Wolf and Dr. Sidney Yankauer for their many invaluable suggestions and my instrument-maker, Mr. Braunesreuther, for his painstaking efforts during the construction of my instruments.

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INTRATRACHEAL INSUFFLATION ANÆSTHESIA.*

CONSIDERED FROM ITS PHYSIOLOGICAL AND CLINICAL ASPECTS.

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THE problem of artificial respiration—that is, the maintenance of a sufficient supply of fresh air to the alveoli—consists clinically of two separate and distinct processes, one or both of which may devolve upon the physician.

I. The maintenance of an unobstructed passage-way for both the afferent and the efferent air current.

II. The maintenance of a sufficient volume flow of air through such passage-way as may be needed (*a*) to supply the requisite amount of oxygen; and (*b*) to remove the excreted CO_2.

The method of intratracheal insufflation aëration, without the necessity of respiratory movements, as recently described by Meltzer and Auer,[50] while ideally simple, fulfils both these conditions and is therefore of great clinical value; this is especially true from the surgical stand-point, as the method likewise permits of the easy administration of the anæsthetic and is particularly applicable to operations within the thorax and those about the head, neck and mouth.

In order to form a correct opinion as to the merit of intratracheal insufflation anæsthesia, and above all to employ the method successfully, it is imperative that one should have the knowledge of the physiological facts on which the method

* Amplification of paper read by the Junior Author to the Obstetrical Society of Boston, November 28, 1911.

is based, as well as the attempts previously made to develop an acceptable technic of artificial respiration devoid of intrinsic danger. Accordingly, an extensive review of the subject seems justified.

Andreas Vesalius,[1] the founder of modern anatomy, discovered that he could prolong the life of an animal after opening its thorax to study the motions of the heart, by blowing through a tube introduced into the trachea. Although Vesalius thus, as early as 1560, in a way, prolonged life by performing artificial respiration with the thorax open, yet we are indebted to Robert Hook,[2] who lived in the latter part of the seventeenth century, for demonstrating that the respiratory movements were simply for the purpose of bringing about a supply of fresh air to the lungs.

The original account of Hook's fundamental experiment of respiration is so pertinent to our immediate problem that I will quote from his article[2] delivered before the Royal Philosophical Society on October 29, 1667:

"I did, heretofore, give this *Illustrious Society* an account of an experiment I formerly tryed of keeping a Dog alive after his *Thorax* was all display'd, by the cutting away of the Ribs and Diaphragme; and after the *Pericardium* of the heart also was taken off. But divers persons seeming to doubt of the certainty of the Experiment (by reason that some Tryals of this matter, made by some other hands, failed of success), I caused, at the last Meeting, the same Experiment to be shewn in the presence of this *Noble Company* and met with the same success, as it had been made by me at first; the Dog being kept alive by the Reciprocal blowing up of his lungs with the *Bellows*, and they suffered to subside, for the space of an hour or more, after his *Thorax* had been so display'd, and his *Aspera arteria* cut off just below the *Epiglottis*, and bound on upon the nose of the *Bellows*.

"And because some Eminent Physicians had affirm'd, that the *Motion of the Lungs* was necessary to Life upon the account of promoting the Circulation of the Blood, and that it was conceiv'd the Animal would immediately be suffocated as soon as the Lungs should cease to be moved, I did (the better to fortifie my own *Hypothesis* of the matter, and to be the better able to Judge of several others) make the following additional Experiment:

"Viz: The Dog having been kept alive (as I have now mentioned) for about an hour, in which time the Tryal hath often been repeated, in suffering the Dog to fall into *Convulsive* motions by ceasing to blow the

Bellows, and permitting the Lungs to subside and lye still, and of suddenly reviving him again by renewing the blast, and consequently the motion of the Lungs: This, I say, having been done, and the Judicious Spectators fully satisfied of the reality of the former Experiment; I caused another pair of Bellows, to be immediately joined to the first by a contrivance I had prepar'd, and pricking all the outer coat of the Lungs with the slender point of a short penknife, this second pair of Bellows was mov'd very quick, whereby the first pair was always kept full and always blowing into the Lungs; by which means the Lungs were always kept very full, and without any motion, there being a continual blast of Air forc'd into the Lungs by the first pair of Bellows, supplying it as fast as it could find its way through the coat of the Lung by the small holes pricked in it, as was said before.

"This being continued for a pretty while, the Dog, as I expected, lay still, as before, his eyes being all the time very quick, and his Heart beating very regularly. But, upon ceasing this blast and suffering the Lungs to fall and lye still, the Dog would immediately fall into dying convulsive fits; but he as soon reviv'd again by the renewing the fulness of his Lungs with the constant blast of fresh Air.

"Toward the latter end of the Experiment a piece of the Lungs was cut quite off; where 'twas observable, that the Blood did freely circulate, and pass thorow the Lungs, not only when the Lungs were kept thus constantly extended, but also when suffered to subside and lye still. Which seem to be arguments, that as the *bare* Motion of the Lungs *without fresh Air* contributes nothing to the Life of the Animal, he being found to survive as well when they were not mov'd, as when they were; so it was not the subsiding or movelessness of the Lungs that was the immediate cause of Death, or the stopping of the Circulation of the Blood through the Lungs, but the want of a sufficient *supply of fresh Air.*"

It is idle to attempt to determine who first applied Hook's use of the bellows (introduced into the mouth) to the human being in an endeavor to revive those suffocated by drowning or other causes. The monographs of Goodwyn[3] (1788), Fothergill[4] (1795), and others show that in the latter part of the eighteenth century the bellows were in general use and were recommended by the Royal Humane Society for restoring drowned people; at this time also overdistention of the lungs was well recognized; likewise the danger of blowing up the stomach, when the larynx was obstructed by the tongue and epiglottis, was appreciated. An attempt to avert the first danger was the adoption of the various forms of graduated piston pumps; to avoid the second, traction on the tongue

was recommended, and if this failed tracheotomy was advised.

The use of intubation for keeping the air-passage unobstructed dates from the day in the latter part of the eighteenth century when Desault [5] accidentally entered the trachea while attempting to perform œsophageal feeding, and found to his surprise that the larynx tolerated the tube for an extended time. As a result, Desault devised the technic of introducing a rubber catheter, carried by a curved probe, into the trachea for the purpose of relieving embarrassed respiration due to stricture of the larynx.

Chaussier,[6] the French obstetrician, in 1805 combined positive ventilation (preferably by mouth) with a metal tube of proper curve and length to enter the larynx for the purpose of initiating respiration in infants which were born in a state of apparent death. The tube of Chaussier met with considerable favor and was variously modified by Dozes [7] and others so as to be available for use with the bellows in restoring those suffocated by drowning or other causes.

The potential power of producing harm by the general use of the bellows in the hands of the untrained led LeRoy [8] in 1827 to make a study of the problem directly from this view-point. LeRoy [9] presented his conclusions in a memoir to the Academy of Science (Paris) in which he showed that emphysema and even death could readily be caused by a too vigorous use of the bellows by the inexperienced. Therefore he recommended a method of respiration by compression of the chest and abdomen; he, however, approved of the maintenance of a free air-passage by means of a tube introduced into the trachea, and accordingly described an instrument designed to aid the introduction of a soft rubber catheter. Magendie,[10] representing a committee appointed by the Academy of Science to investigate LeRoy's assertions, reported in the affirmative as to the dangers of positive pulmonary ventilation; accordingly the use of the bellows was practically abandoned and along with it the tracheal tube.

Depaul [11] in 1845 made an attempt, only partially successful, to again popularize the tube of Chaussier [6] in the treatment of the drowned and especially in initiating respiration in the new-born. This method, however, fell into final disuse as a result of the efficient and safe method of artificial respiration proposed by Marshall Hall [12] in 1856. Aside from producing contraction of the chest by pressure (with passive expansion) as suggested by LeRoy,[9] Hall's essential point consisted in maintaining a free air-passage by adopting the prone position, which allowed the tongue and epiglottis to fall forward and therefore out of the way of their own accord.

Bouchut [13] in 1857–8 clearly and accurately described tubage of the larynx for croup; strong opposition was at once aroused by Trousseau and his followers, who had lately popularized tracheotomy for this con-

dition, and intubation failed to establish itself. In 1871 Weinlechner,[18] apparently without knowing of Bouchut's suggestion, proposed catheterization of the larynx in croup; again the idea did not meet with a favorable reception. O'Dwyer,[24] of New York, in 1885 described an exceedingly practical tube and introducer that became at once popular, and which has with a few modifications remained the generally accepted tube for use in diphtheria.

In 1887 Fell[20] of Albany saved a severe case of opium poisoning by the use of his laboratory respiration apparatus, consisting of a bellows and tracheotomy tube. Against the opposition of his colleagues he popularized his method as "forced respiration" and claimed it as a wonderful discovery; we have seen above how similar procedures had been used as early as the latter part of the preceding century and that they had been eventually discarded on account of their intrinsic dangers. In 1894 Northrup[29] combined the "forced respiration" as described by Fell with the laryngeal tube of O'Dwyer. This Fell-O'Dwyer method was taken up by Matas[38] and used in intrathoracic work shortly afterward, and its advantages set forth by him in a masterly monograph in 1900.

Likewise Maydl[25] and Eisenmenger,[27] both of Vienna, published in 1893 descriptions of tubes modified from that of O'Dwyer, to which they connected rubber tubing, on the end of which was attached a funnel for administering ether after the style of the apparatus used by Trendelenburg[15] for administering the anæsthetic through a tracheotomy wound; they used it for extensive operations about the mouth, for by this means they could pack the larynx and prevent entrance of blood into the trachea and lungs; the patient, of course, had to respire voluntarily.

Kuhn,[35] of Germany, has done more than anyone else during the last 15 years in attempting to develop and popularize a laryngeal tube that would be practical and useful in surgical work about the head, neck, and mouth, as well as lately within the thorax. His earlier apparatus, like that of Maydl and Eisenmenger, consisted of a modified O'Dwyer tube to which he attached, by rubber tubing, a funnel. This, of course, increased his "dead space," to avoid which he later used a two-way tube to allow easy exit to the air. Finally, in 1908, he[47] adopted a method which came very near being perfect; through a large laryngeal tube he introduced a smaller tube which conducted a steady stream of air into the upper part of the trachea under a constant pressure; the return flow escaped through the space between the inner and outer tubes, the resistance of which created a sufficient pressure for intrathoracic work. Such an apparatus was simple, uncomplicated by valves, and quite efficient; Kuhn's method, however, failed to do away with the dead space between the larynx and the bifurcation of the trachea and so was dependent on respiratory movements to bring about a sufficient exchange of air, and it is in this essential point that it differs from Meltzer and Auer's perfected method. In short, Kuhn never appreciated either the desirability or the practicability of respiration without the necessity of respiratory movements.

The probable great value of some form of static differential pressure

for intrathoracic operations led to considerable experimental activity along this line in the laboratory of Francois Frank, and as a result we find two forms of positive pressure apparatuses emanating from this laboratory as early as 1896. Tuffier and Hallion[81] proposed a method whereby the disadvantages and dangers of pumping air in and out of the lungs were avoided by connecting with a pressure reservoir a tube introduced through the mouth and made to fit the trachea tightly by a specially designed clamp; by suitable valves the expiration was opposed by a water valve of 20 cm. pressure, thus keeping the lungs distended. The exchange of air, however, had to be entirely maintained by the natural respiratory movements of the animal against this pressure. Quénu and Longuet[82] arrived at the same result by using a head-piece or mask, like a diver's helmet, in which positive pressure was maintained and which proved to be the forerunner of the later improved positive pressure cabinets.

In 1904, Sauerbruch,[86] at the instance of Mikulicz,[88] made a most comprehensive study of the question of surgical pneumothorax. His monograph stands as the basis of all recent work on the subject; in this Sauerbruch followed up the suggestion made by Woillez[18] in 1875 as to the advantages of negative as opposed to positive pressure, and enlarged the latter's "Spirophore," first to a small cabinet just large enough for animal work, and then into his now famous negative pressure operating room with its complicated accessories. The evident excellence of this piece of work, backed by the prestige of Mikulicz, brought about the general acceptance of Sauerbruch's conclusions in regard to the advantages of negative as opposed to positive pressure, notwithstanding the fact that Brauer[87 89] and many others soon demonstrated that physiologically there is no difference between the two methods, and that from the practical stand-point the positive pressure apparatus is preferable. All are, in a general way, familiar with the various differential pressure apparatuses as devised by Sauerbruch, Brauer, Tiegel,[40] Meyer,[54] Robinson,[58] and many others, by means of which great advance has recently been made in thoracic surgery; accordingly we will not consider the details of the various modifications.

However, all these differential pressure apparatuses, whether negative or positive or even combined, are designed to render possible *spontaneous respiration* under conditions of surgical pneumothorax; they do not provide any efficient and practical means of aiding respiration, whenever for any cause such spontaneous respiration ceases. Further, it is practically impossible, or at least very difficult, in the case of an anæsthetic accident for the administrator to render material assistance on account of the mechanical interference of the apparatus. In consequence it is no wonder that a method,

such as Meltzer and Auer have described, which when properly conducted renders death from cessation of respiration impossible, whether the thorax be open or closed, has created a tremendous interest in the surgical world.

The first investigator, since the time of Hook in the 17th century, to consider the question of artificial respiration without the necessity of respiratory movements, excepting Nagel[34] working on birds, was Volhard.[48] The latter in 1905, through his pupil Hans Hirsch,[41] published a series of experiments. By the use of a small stream of oxygen introduced a short distance into the trachea, they succeeded in maintaining the animal alive for a period of about two hours, when death would occur from an accumulation of CO_2; if air was used, the animals would die much quicker. The failure of the method was due to the smallness of the oxygen or air stream, which, though sufficient to maintain oxygenation, was not of such volume and pressure as to maintain the lungs in a state of distention, whereby diffusion and the removal of the secreted CO_2 could take place.

Robinson[48] in 1908 repeated the Volhard experiment through a tracheotomy wound; he came somewhat nearer to the goal in that he used a current of air which maintained the lungs in a state of at least partial expansion; he also recognized the necessity of reducing the dead space for CO_2 retention, though he failed to specifically direct that the tube should be introduced to the tracheal bifurcation.

Let us now briefly enumerate the advantages of the method of Meltzer and Auer[50, 52] as clinically used.

By means of a soft rubber catheter the air with its requisite amount of ether is carried directly to the bifurcation of the trachea; from this point there is a constant return stream between the catheter and the wall of the trachea to the free air. The size of the catheter should be about a No. 23 F; its exact size in comparison with the trachea is immaterial within considerably wide limits, and we have found this one size to be suitable for all adults. The escape of the air from the end of the catheter and its return through the trachea create air currents in the bronchi which greatly aid diffusion. Therefore it is very easy to supply the patient with as much oxygen as he needs, and also to remove all the CO_2 excreted. If the thorax is opened, the resistance to the outflow is sufficient to maintain the lungs in moderate expansion; complete expansion is not only unnecessary but it is undesirable from

the surgeon's stand-point. If, for any reason, the patient should appear under-aërated, it is a simple matter to interrupt the current for a few seconds and allow the lungs to subside and completely empty themselves, as suggested by Meltzer and Auer in their more recent articles. This, however, is only occasionally necessary, as will be more fully pointed out later. On closing the thorax, gentle pressure on the trachea increases the resistance to the outflow, so that the lungs may be made to completely expand and obviate post-operative pneumothorax. If you have removed a whole or a half lung, do not expect that the remainder can safely be made to fill the thorax immediately.

It is perfectly possible to maintain efficient aëration by this method indefinitely, as Meltzer and Auer's experiments on curarized animals show. We have kept a cat anæsthetized 16 hours by gas and oxygen administered intratracheally with both pleural cavities widely opened; on the discontinuance of the anæsthetic the animal recovered within 15 minutes, though in a state of exhaustion from its all-night exposure in a cold room.

The question of providing a free return of the air through the larynx and mouth must be seriously considered. In the first place, the tongue is apt to drop back and offer just sufficient resistance to direct some of the air down the œsophagus into the stomach. This is quite a common occurrence, and may easily be avoided by holding the tongue forward by either forceps or a stitch.

A more serious question is that of *spasm of the glottis,* in which the vocal cords shut down more or less tightly around the catheter.

This spasm of the glottis only occurs when the patient is light and the administration of ether soon brings about relaxation of the cords. Personally I have never seen the cords grasp the catheter so tightly as to obstruct all reflux of air, and believe its occurrence highly improbable. If complete closure should occur, it would of course be impossible to administer the anæsthetic to bring about relaxation; there-

fore Meltzer and Auer's method of interrupting the air current and allowing the lungs to subside should be intermittently practised until the addition of ether brings about relaxation, when the necessity of this procedure will be found to have ceased. A two-way tube, such as that recommended by Kuhn, we do not like, as it lacks the advantage of blowing out the mucus from the trachea; in oral surgery the prevention of the inhalation of blood is a distinct factor in the preference for a one-way tube.

That spasm of the glottis with partial obstruction to the return flow for a few minutes is common there is no doubt. In consequence, at the very first a mercury safety-valve * of 15 mm. pressure was introduced by us into the air current of the apparatus we used; this factor of safety is likewise incorporated into Ehrenfried's [75] apparatus. Such a safety-valve effectively prevents any danger of excessive distention of the lungs with resulting emphysema or even death. In a very extensive use of the method in all kinds of abdominal and thoracic work on animals, and a moderate clinical experience, the only death or suggestion of trouble we have seen was due to acute distention of the lungs in a cat by a high pressure. The accident occurred because we had removed from our laboratory apparatus the mercury safety-valve for use in clinical work; after introducing the tube and while washing our hands, and as usual paying no attention to the animal, spasm of the glottis occurred which resulted in death, probably within 15 seconds, as we were using the high pressure supplied by the school. Had the safety-valve been in use when the spasm of the glottis occurred, we should have heard it bubbling; the addition of ether to the air would immediately have overcome the spasm and the animal would have been in no danger.

We are inclined to think that most of the trouble of Meltzer and Auer, as well as others, in obtaining a tube suitable for

* We have repeatedly called attention [57] to the necessity of a safety-valve; in spite of this accidents are still occurring from failure to have an efficient one on the apparatus.

the case is due to partial spasm of the glottis. Our reasons for this belief are that we always use the same tube for all sized cats and always a No. 23 F soft rubber catheter in our clinical cases (adults), without the suggestion of any trouble other than that noted of temporary partial closure of the glottis. Further, this phenomenon can be readily studied in the cat; with the head extended the cords can be seen partially open; on attempting to introduce the tube when the animal is "light" the irritation of the tube in the pharynx and against the epiglottis causes the glottis to close; therefore in order to introduce the tube the anæsthesia must be pushed to such a depth that the pharyngeal and laryngeal reflexes are overcome—then the cords are seen to be widely open, and they do not contract on introduction of the catheter. After the introduction there is always a free return of air for several minutes or until the cat becomes "light," then the cords can be seen to close around the catheter; the mercury safety-valve bubbles; the tongue and nose become gradually cyanotic, and the animal appears to enter a dangerous state. At first we did not know exactly what to do; experience in a large number of animals has proved that the administration of ether (strong, the current bubbling through the ether) quickly deepens the anæsthesia sufficiently to overcome the reflex spasm; reflux of air takes place and the animal is again "safe."

In one of their earlier papers, Meltzer [55] and Auer make the statement that an animal cannot be given too much ether by their method, and attempt to explain the fact as an intrinsic virtue of intratracheal insufflation. That they with their apparatus were not able to excessively etherize their animals we do not doubt; their attempted explanation, however, is all wrong, and the error should be strongly brought out. (This they have recently done.) The question of ether dosage is merely the one of proportional arrangement between the volume of the air current and the size of the ether bottle, together with the particular arrangement of the tubes within the bottle. It is easy to arrange the ether bottles and tubes

so that the air in passing through the bottle may take up such a large percentage of ether that the animal dies within five minutes from ether poisoning.

Ehrenfried has adopted in his simple intratracheal apparatus what we have in our gas-oxygen apparatus, namely, an arrangement of tubes and valves so that the air and gases may be passed partly or entirely over the surface of ether or made to bubble through the ether.

We consider it essential for an apparatus for anæsthesia by the vapor method, whether or not intratracheal, that it be possible to give a large percentage of ether for a short period or until the patient is relaxed; as soon as relaxation occurs, and this is possible in every case, including alcoholics, the strength of the ether vapor is decreased or it is entirely discontinued as may be indicated. It goes without saying that liquid ether should not be blown into the bronchi; with positive prevention of this any apparatus is simplicity itself (three inches of glass tubing lightly packed with cotton or gauze inserted into the current). On the other hand we have seen no satisfactory evidence produced that ether vapor, whether or not produced by bubbling a stream of air at room temperature through the ether or by passing it over the surface, causes injury of the lungs provided it be administered in doses suitable for anæsthetic purposes. A very extensive series of major operations on cats (blood-vessels), in which we used the bubble principle exclusively, as it allows us to properly conduct the anæsthesia by stepping on the by-pass tube with our foot, has failed to show any injury to the lungs that can be perceived clinically. There is one point, however, against which we wish to caution in regard to the use of ether vapor methods in which the apparatus is warmed and that is the danger of using too much heat so that pure ether vapor is boiled over; remember that ether boils at a temperature below the body (96.5° F.). Also remember that the excessive cold produced by the evaporation of any liquid occurs at the point where the liquid is converted into a gas; therefore after the change has taken place, on account of the

light weight and actual small substance of a gas, the latter acquires the temperature of its surrounding body without adding or subtracting materially from the temperature of that body (referring to volumes such as would be used for anæsthetic purposes). In other words air at room temperature bubbling through ether is again at the same temperature after passing through three feet of rubber tubing.

Using a small bottle and passing the air over the surface of the ether lowers the temperature of the air in the bottle to such a point that the percentage of ether taken up by the air is below that which produces an anæsthesia of sufficient depth to abolish laryngeal and pharyngeal reflexes. This difficulty can be overcome (*a*) by immersing the small bottle in hot water or other heating device, (*b*) by using a large bottle, thus giving large evaporating surface and therefore capable of being kept warm by the room temperature.

We believe that the air and ether vapor should be delivered to the patient at least within a few degrees of the room temperature; as this is obtained by the use of a large ether chamber and three feet of tubing we do not believe in complicating the apparatus with a heating device. If, however, only a small ether chamber is available, it must be heated in order to get a sufficiently high percentage of ether vapor. We cannot agree with Gwathmey's contention that air and ether vapor *superheated* above the room temperature usually respired is of benefit.

Some anæsthetists make it a practice to combine chloroform vapor with ether either together or in sequence. These combinations are based on the supposed inability to relax the patient by ether vapor; there is no foundation for this supposition, provided the ether bottle is of sufficient size and the tubes are properly arranged. Some two or three decades ago there occurred many deaths in England from the use of chloroform by the closed or vapor method; let us not repeat this sad history by producing a similar series of deaths from the same cause in this country. In contrast to the known great danger of the closed method of chloroform

anæsthesia, the theoretical supposition of lung injury from ether administered by the vapor method of sufficient strength to properly anæsthetize the patient, as opposed to a sufficient amount given by the cone, is too far fetched to be seriously considered by those acquainted with all the available facts. In short we wish to most strongly advise against any such use of chloroform in connection with the intratracheal method.

Instead of ether being carried by an air current as the anæsthetic agent by intratracheal insufflation method, we recently reported the use of nitrous oxide-oxygen-ether as the anæsthetic. A moderate though not extensive use of this latter combination both in humans and in animals still leaves us undecided as to its desirability. We hope shortly to have a series of cases of sufficient length to justify an opinion on the subject.

If it is desired to use nitrous oxide-oxygen as the carrier of the ether vapor, our apparatus [88] is capable of efficiently and safely doing this. By means of a Y connection the mercury safety-valve is attached. To take care of the irregularity in the outflow caused by the respiration of the patient and to supply the extra quantity of gas-oxygen needed on inspiration, thus obviating the sucking in of air around the tracheal tube, a small rubber bag is inserted near the patient.

The question of the CO_2 content of the blood is one of great importance. Haldane and his co-workers in England have shown that the normal respiratory movements are governed by the percentage of CO_2 in the blood; they have further shown that excessive respiration quickly reduces the total amount of CO_2 in the body, resulting in a condition of apnœa, lasting until the CO_2 is reaccumulated. Henderson [80] has recently advanced the hypothesis that a material decrease from the normal total quantity of CO_2 in the body, by its effect on the circulation, is as dangerous to life as an increase. The symptoms of an abnormal decrease in the CO_2 content of the body in regard to respiration, if uncomplicated by other stimulating factors, is a condition of apnœa; if hyperpnœa is in any way maintained by artificial respiration

or by strong stimulation of the respiratory centre by pain, the increasing reduction of the CO_2 content shows its harmful effect on the circulation by bringing about a progression of symptoms ending in a picture clinically similar to that commonly known as shock. It is very reasonable to suppose that a material decrease in one of the normal constituents of the body is as harmful as its increase; in consequence, the theory of acapnia and its relationship to shock deserves an extensive clinical investigation to see whether or not it agrees with the findings of the physiological laboratory.

In a brief series of cases we found, at least in certain cases, that there is clinically a relationship between acapnia and shock. These cases will be shortly published,[90] and it is our hope that some means will be found adaptable to clinical use for the determination of the CO_2 content of the blood; whether or not we will be able to obtain alveolar air for this purpose is questionable, though that at the present time it seems the more practicable method.

In a recent article Henderson states the question of CO_2 relationship in regard to the ordinary administration of ether very clearly. We wish to call attention to a few points in regard to CO_2 elimination by the intratracheal method. By this method increased respiratory movements or attempts at movements will be increased whenever there is an inefficient removal of the excreted CO_2; the remedy is to increase the volume of the stream (not the pressure). If the CO_2 is at the normal point, the patient will make what appear ordinary light respiratory motions. On the other hand, as soon as one produces excessive aëration and CO_2 removal, one will produce first a condition of apnœa, which if prolonged will result in the picture of shock; when the apnœic condition develops, one must decrease the volume of air or of nitrous oxide and oxygen and allow a reaccumulation of CO_2 in the body. The aim of the anæsthetist is to maintain the CO_2 content of the blood as near normal as possible; therefore, one should take care to maintain one's volume of air or combined gases so that the patient breathes or rather attempts

to respire in a practical normal manner. In anæsthetic accidents in which apnœa develops as a result of acapnia by the cone method of anæsthesia, it is sometimes difficult to restore respiration before the patient dies of anoxæmia. By the intratracheal method such death from anoxæmia due to lack of respiration is impossible, and with only moderate care not more than a mild condition of acapnic shock is possible; and even this can be avoided by maintaining the patient in such a state that spontaneous respiratory movements occur, though they may be safely reduced both in frequency and depth.

The introduction of the catheter into the trachea when the patient is deeply anæsthetized is comparatively easy by means of the instrument perfected by us,[83] provided that the anatomy of the oropharynx and of the larynx is understood. With the patient deeply anæsthetized, the introduction is as follows: Arrange the head so that it is slightly extended; this procedure puts the larynx and trachea on the stretch and the lumen is maintained by the rigidity of the cartilages of the larynx while the œsophagus is pushed back, the pressure tending to keep the latter opening closed. Pull the tongue moderately forward, introduce the finger till it passes over the tip of the epiglottis; insert the introducer with the catheter projecting one-third of an inch, over the back of the finger, along down, hugging tightly the posterior surface of the epiglottis, keeping always in the median line, till the handle of the instrument is at right angles to the body (not at right angles to the mouth if the head is more than slightly extended); then feed the catheter and it will slide directly into the trachea.

However, there is one mistake in attempting to introduce the tube that nearly every beginner makes—that is, depressing the handle of the instrument too far, or in other words carrying it beyond a right angle to the body. This mistake directs the catheter against the anterior wall of the larynx at the base of the epiglottis between the thyroid cartilage and the hyoid bone. This space, as seen on the median section, is merely covered over by the thyrohyoid membrane, over

which are two very thin muscles. In short, pressure here readily develops a pocket into which the tip of the catheter slides and this prevents its further progress. An assistant can materially aid the introduction by gently exerting counter-pressure over the thyrohyoid membrane and the thyroid cartilage.

Personally we have never seen any injury to the larynx by the tube and believe it is unnecessary. To be sure, when learning how, we occasionally slightly injure a urethra in passing a sound, but that is overcome by practice. We believe the same will be found to be true of catheterization of the trachea. If possible, preliminary practice should be made on the cadaver; at least the anatomy of the parts should be well understood. We have heard of one or two cases of aphonia lasting two or three days after a troublesome introduction, but nothing more serious.

The following conclusions we feel are justified:

1. Intratracheal insufflation respiration is the only artificial method that absolutely provides for a sufficient aëration of the lungs, regardless of the respiratory movements of the patient, and that properly administered and safe-guarded can be rendered devoid of intrinsic danger.

2. In consequence, anæsthesia by this method is indicated whenever the operation is about to interfere in any way with the ability of the patient to voluntarily respire.

3. Therefore it ought to be used in all intrathoracic work and in extensive operations about the head, neck, and mouth.

4. Of the various anæsthetics to be used with this method, ether with air, preferably supplied by a foot pump,* is the most applicable for general use; however, nitrous oxide-

*At the new Brigham Hospital the operating rooms are provided with compressed air from the central power plant; we are going to use Connell's meter and percentage ether apparatus by which the quantity of air administered and the actual amount of ether used are determined with nearly absolute accuracy; it is a wonderful piece of apparatus and will be of immense benefit for teaching purposes (paper about to be published). For those hospitals that desire an efficient, simple, and inexpensive apparatus, that designed by Dr. F. L. Richardson of Boston is by far the best (paper about to be published).

oxygen with minimal quantities of ether may occasionally be the anæsthetic of choice.

5. To prevent deaths from emphysema, no matter what form of apparatus is used the same must be provided with a *safety-valve* by means of which the intrathoracic pressure cannot exceed 15 mm. mercury.

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THE ANÆSTHETIC EFFECTS OF THE INTRAVENOUS INJECTION OF PARALDEHYDE.

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IT has long been recognized that paraldehyde is in many ways the most perfect hypnotic we possess. In certainty of action it is unsurpassed, while its stimulating effect upon respiration and circulation and its absence of after-effects are in marked contrast to the depression, immediate and remote, produced by other hypnotics. Given by mouth, its taste is a serious disadvantage, and the preliminary excitement it may sometimes cause is undesirable.

It appeared to us that these defects could be largely overcome by intravenous injection, and the results of our experiments have exceeded our expectations. The hypnotic effect is the most perfect we have ever seen, being exceedingly rapid and yet devoid altogether of unsatisfactory circumstances. The patient appears both to himself and to onlookers to pass into a perfectly natural and easy sleep. Respiration deepens, the pulse is slower and fuller, the color is absolutely unaltered. Yet if the injection be continued deep anæsthesia can be produced with great rapidity. This latter fact opens up a wide field upon which we hope shortly to make a further communication. Here we shall restrict ourselves to the use of paraldehyde intravenously as a hypnotic or as an anæsthetic for minor operations.

Paraldehyde is a colorless, volatile liquid with a characteristic and unpleasant taste and smell. Its sp. gr. is .998, it is soluble in 10 volumes of water at 15° C., less soluble in hot water, and boils at 124° C. It is miscible in all proportions

with ether and alcohol. Under ordinary circumstances it has no depressing effect upon the heart. Intravenously we found it to act momentarily as a depressant. This effect is transient and can be entirely eliminated by combining in the injection an equal amount of ether. The action of paraldehyde is so rapid that we preferred to retard it by dilution. We therefore mix 5 to 15 c.c. of paraldehyde with an equal amount of ether and dissolve the mixture in 150 c.c. of a cold 1 per cent. solution of sodium chloride in sterile distilled water *free from dead bacteria,* or, in default of this, in ordinary boiled tap water. The solution should be perfectly clear after shaking. It is placed in a sterile bottle with a rubber stopper through which pass two glass tubes. To one of these tubes a bellows is attached. The other reaches to the bottom of the liquid and leads off by a long rubber tube to a fine hypodermic needle. The apparatus we have used is that devised by Fildes and Macintosh for the injection of salvarsan. The solution may be injected cold or at a temperature not exceeding 25° C. The patient's arm being surrounded with a light tourniquet bandage, a prominent vein is selected, the skin is cleansed with ether and the needle inserted. A back flow of blood through the needle into a glass tube in the rubber connection shows that the vein has been entered. The tourniquet is removed, the bellows worked, and the fluid is steadily driven into the vein at the rate of 5–10 c.c. per minute. The following phenomena are observed:

In 5 seconds the patient tastes paraldehyde.

In 10 seconds it can be detected in the breath. The patient has a sensation of general warmth.

In 20 seconds the patient has a sensation of floating and perhaps of slight dizziness.

In 30 seconds consciousness is disappearing.

In 40 seconds unconsciousness is complete.

In 60 seconds the patient is deeply unconscious.

In 90 seconds the corneal reflex is absent and anæsthesia is complete. Reflex movements may, however, occur.

Up to this point about 5 c.c. to 10 c.c. of paraldehyde will

have been given and small operations, such as removing teeth or suturing wounds, may be performed. The drug is, however, excreted by the lungs with great rapidity, and for a lasting effect the whole 15 c.c. will usually be required.

The later effects of the drug depend largely on the amount given. With a small dose (5 c.c.) the patient passes through a short period of anæsthesia into an easy and natural sleep. The duration of this appears to depend on the condition of the patient and not on the drug, the action of which is over in perhaps 20 minutes. Thus in a case where six teeth were removed under 10 c.c. of paraldehyde and 10 c.c. of ether the patient was conscious in 20 minutes and had entirely recovered in half an hour. In another instance where the drug was used as a hypnotic six hours of natural sleep resulted. In both cases the patients appeared on waking to have simply been roused from sleep. No after-effects of any kind occurred in either case.

The most striking results were seen in the case of alcoholics, both acute and chronic. One powerful laborer with a scalp wound and incipient alcoholic dementia was sleeping peacefully in 40 seconds, realizing too late that anything was being done. His scalp wound was sutured without disturbance. In such cases, however, intravenous paraldehyde is too transient and should be backed up at leisure with slower drugs, such as potassium bromide and chloral given by rectal or nasal tube, or by paraldehyde itself given in the same way or into the muscles. It is, however, this rapidity of excretion which gives one such confidence in the use of so potent a drug intravenously. At each instant the patient exhibits the maximum effect of the dose so far given. The dosage is, therefore, under absolute control, and hence there is never any danger from an overdose. The moment injection ceases the effect of the drug begins to pass off as the drug itself pours out through the lungs. We therefore consider the use of intravenous paraldehyde to be practically safe, and we have ventured to use it as a hypnotic in cases of grave cardiac and pulmonary disease with perfect success. We do not suggest it can replace the slower but more

lasting hypnotics; but we draw attention to it as a method by which, under the most trying circumstances, we have never failed to induce within 60 seconds a condition closely resembling normal sleep. We feel that such a method must have a future both in medicine and in surgery.

We can find no record in the literature of the previous intravenous use of paraldehyde. We append a list of some of the more important papers on the subject of intravenous anæsthesia.

We should like to thank the staff of the London Hospital for the facilities we have been granted for the introduction of this new method.

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TRAUMATIC RUPTURE OF THE SPLEEN (COMPLETE); SPLENECTOMY.

BY A. M. FAUNTLEROY, M.D.,

Surgeon, U. S. Navy.

THE subject of this report is a young man, 24 years of age, who was received aboard the U. S. hospital ship *Solace* in the early morning of September 9, 1912, with a history of having fallen from the spar deck of the U. S. S. *Ohio* to the water, a distance of forty feet, striking his left side on the gunwale of a whale-boat which was moored alongside the battleship. He was rescued immediately, and, upon being seen by the ship's surgeon, exhibited unmistakable signs of shock, for which he was given morphine, Gr. ¼, and atropine, Gr. 1/150, by arm, and preparations made for his immediate transfer to the *Solace*.

Examination on admission to the *Solace* showed the patient's general condition to be very good, with a temperature of 98.4° F., pulse 80 and of good quality, and respirations 29. He was catheterized immediately, and, though the small amount of urine withdrawn was clear, it was sent to the laboratory for examination. The report on this urine shortly afterwards showed it to contain a heavy precipitate of albumin, with numerous granular casts, but no red blood-cells were present. There was evidence of severe contusion over left abdomen and lower ribs, but there was no abrasion of the skin, nor were any bones broken. There was a noticeable rigidity over entire abdomen, and this was markedly increased over upper left quadrant, in which region there was also considerable pain and tenderness. There was no unusual dulness in left flank, and patient had not been nauseated. He complained of a curious, deep-seated pain in left shoulder, which was not increased by movement of the joint, and, as examination showed no contusion or dislocation, it was thought to be a slight sprain in this region, due to an effort to catch himself in falling. It is to be noticed, however, that this pain disappeared completely after operation, and it is possible that it has some diagnostic value when the spleen is traumatically involved.

As there were no signs of internal hemorrhage, it was decided to treat the case expectantly under close watch and at the same time be ready for operation, should one be indicated. In this connection, on account of the condition of his kidneys, it was deemed advisable not to subject the patient to an exploratory operation for diagnostic purposes, but rather to wait until there was more pronounced evidence of internal trouble, and thus not cause what might turn out to be an unnecessary depression of the kidneys incident to the anæsthetic.

For three hours after admission there was practically no change in temperature, pulse, or respiration, and the rigidity in upper left quadrant remained the same. Shortly after this time patient experienced slight nausea and vomited a small amount of light-greenish fluid. There was also at this time what appeared to be an increased desire for water, though there was not the slightest evidence of syncope or restlessness. Operation was decided upon for the following reasons: the continued marked rigidity, in connection with pain, in upper left quadrant, and a slight tendency to nausea (vomited once), indicating a possible accumulation of fluid in the abdomen.

Operation.—Ether anæsthetic. Incision made along the outer border of left rectus, which was later augmented by transverse incision along lower border of ribs, making in all an L-shaped incision. On opening the abdomen there was at first no evidence of hemorrhage, but, on separating the slightly-distended coils of intestine, small clots began to appear. The spleen was immediately sought for, and a large clot located under the diaphragm and completely surrounding the spleen. A tentative effort was made to deliver the spleen, but, on account of what afterward was discovered to be the shortness of the pedicle and adhesions, this could not be done at this time. The next step was to free the stomach by ligating and dividing the vasa brevia as quickly as possible. This accomplished, the pedicle was secured by a large clamp, guided by the fingers of the left hand. Up to this time the displacement of the clot had caused considerable hemorrhage, but as soon as the pedicle was secured this was seen to be controlled. The clot and fluid blood were now carefully expunged and a better view of the parts obtained. It was noted that not only was the pedicle very short, but the entire posterior border of the organ was held down by reflected

peritoneum or adhesions. These latter were carefully broken up by finger dissection and the lower part of the organ brought up into the wound. It was now seen that the organ had been completely torn across about its middle, and that, in order to secure the pedicle, it would be necessary to include a portion of the tail of the pancreas in the ligature to prevent slipping. This was accomplished with heavy silk, the pedicle being ligated in two sections and the entire organ delivered. The wound, after thorough mopping of the abdomen, was closed in layers, heavy chromic gut being used for the deep sutures and linen for the skin. No drainage was used.

After-treatment and Results.—Patient reacted slowly after operation, and for twenty-four hours normal salt solution was given slowly per rectum for its general tonic effects and to flush out the kidneys. For the succeeding ten days a strictly milk diet was given and the patient encouraged to drink plenty of water. The urine at first showed considerable albumin, with a few granular casts, but by the end of ten days this had entirely cleared up and the patient was put on a more liberal diet of potatoes, toast, butter, and coffee. After this, 24-hour specimens of urine, for two weeks, showed normal quantity and quality, and the examinations were then discontinued. During convalescence there was an indication, at times, of a nervous involvement, such as fleeting headaches, insomnia, and an apprehensive nervous attitude toward attendants. This, however, slowly passed away, and no untoward symptoms were noted, except an occasional colicky cramp over abdomen, which sometimes lasted for twelve hours. An enema and hot-water bag usually relieved these pains. No bone pains were noted, nor was there any enlargement of the superficial glands. The blood picture, as noted by a white, red, and differential count every day, showed nothing unusual or worthy of note. At the present time, one month after operation, patient is up and around, has regained his normal weight, bowels moved regularly, feels perfectly well, eats and sleeps normally, and will be shortly returned to duty.

A remarkable feature of this case was the comparatively small hemorrhage present when one took into consideration the

FIG. 1.

Ruptured spleen, external surface.

FIG. 2.

Ruptured spleen, inner surface.

extent of injury to the organ. One explanation of this may be that the adhesions present bound the organ down in such a way as to limit the flow of blood and favor clot formation. The peculiar pain in the left shoulder, which disappeared after operation, may be worthy of remembering in connection with a traumatized spleen, but only further confirmatory observation along this line could dignify this symptom into anything like a pathognomonic sign.

The accompanying photographs (Figs. 1 and 2) show the internal and external surface of the spleen after the specimen had been in alcohol for two weeks.

SPONTANEOUS RUPTURE OF THE MALARIAL SPLEEN.

A REPORT OF THREE CASES.*

BY LLOYD NOLAND, M.D.,

Chief of Surgical Clinic, Colon Hospital, Panama Canal Zone,

AND

FRED C. WATSON, M.D.,

Colon Hospital.

SPONTANEOUS rupture of the spleen occurring during attacks of malaria, or as a sequel of malarial infection, is, we believe, of sufficient rarity and interest to justify the presentation of this paper. All text-books on internal medicine, and especially those devoted exclusively to tropical diseases, mention and emphasize the fact that the malarial spleen is particularly liable to rupture as the result of severe or even trivial injury. Most workers of extensive tropical experience have frequently encountered such cases. That the malarial spleen may rupture spontaneously is admitted by many writers, but specific instances are rare. We have been unable to make an extended search of the literature on this subject, but the following isolated authentic cases have been found:

CIMBALI, quoted by Litten,[1] observed rupture of the spleen in a man of 65 who had enlargement of the gland, the result of malaria. One morning, as the patient was getting out of bed, he suddenly felt a severe pain in the left side, and soon turned pale and cyanotic and died. A tear, three or four cm. in length, was found in the upper end of an enormously enlarged spleen. Davys, quoted by George G. Ross,[2] reports a spontaneous rupture of the spleen in a native of India while lying down. Death occurred in one-half hour. Autopsy showed a soft and enlarged spleen with a rent in its anterior angle. Berger, also quoted by Ross,[3] reports a similar case. Borrallier, quoted by Douglas,[4] reports a case of spontaneous rupture of the spleen, following several attacks of ague.

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* From the Surgical Clinic at Colon Hospital, Cristobal, C. Z.
Read before the Canal Zone Medical Association, September 11, 1912.

From the clinical and autopsy records of approximately 30,000 cases of malaria, admitted to the wards of Colon Hospital during the past eight years, we have found only three instances of spontaneous rupture. In each of these cases a close and careful questioning failed to elicit a history of trauma of even the mildest degree. In the Isthmian Canal service all employees injured in line of duty receive full compensation during the period of their disability, if not in excess of one year. Employees on the " silver roll " (laborers and so forth) receive no compensation for illness. In consequence of this rule claims of injury are made on the least excuse possible. The denial of injury by these patients is, therefore, of added value.

CASE REPORTS.

CASE I.—N. H., case No. 22,100, Barbadian, male, age 22, black, occupation laborer, on Isthmus 2 years, admitted to Colon Hospital February 2, 1910.

Past History.—Was never sick until after coming to Isthmus. Has never had typhoid or dysentery. Has had four light attacks of " fever " in past two years. Has never been admitted to hospital previously. Denies venereal or alcoholic history.

Present Illness.—Was taken sick January 28 with headache, backache, fever, and pain in left side at costal margin. Continued at work until day of admission, though suffering with fever and headache daily. Has not been injured in any way.

Physical Examination.—Patient well nourished. Lungs and heart negative. Abdomen tender in left hypochondriac region. Slight rigidity of left rectus and oblique. Spleen palpable at costal margin. Tongue coated. Sclera jaundiced. General glandular enlargement. The blood examination was positive, showing a light, æstivo-autumnal infection. Hæmoglobin 68 per cent. Leucocytes 13,100. Stool examination negative. Urine negative.

Case History.—The temperature on admission was 102° F. Pulse 124. Respiration 30. From February 2 to February 6 the temperature ranged from 99.5° to 104°. On February 7, 8 and 9 the highest point reached was 102.5°, and the lowest

100°. The pulse-rate was high for malaria, averaging 110. Routine quinine treatment, grains 15 t.i.d., was instituted on admission. The patient complained of increasing pain in the left side on February 9 and developed marked rigidity of the abdominal muscles. On this day the leucocyte count was 20,000. Differential count: Polynuclears 60 per cent.; small lymphocytes 15 per cent.; large lymphocytes 15 per cent.; transitionals 9 per cent. Blood culture taken February 7 was reported sterile. The patient was transferred to the surgical side with a tentative diagnosis of splenic abscess. Operation was urged, but was refused by the patient on the 9th, 10th, and 11th, but was finally consented to on the 12th. During these days the pain became increasingly severe, with constant and marked abdominal rigidity, but without vomiting or constipation. There was intense local tenderness in the left hypochondriac and epigastric regions.

Operation (February 12, 8 A.M.) (Dr. Noland).—Ether anæsthesia. The abdomen was opened by a free left rectus incision. The peritoneal cavity contained a small amount of dark fluid blood, probably not more than 500 c.c. The spleen was enlarged to almost twice its normal size, and was densely wrapped in omentum, which was separated with some difficulty. A rent of about one and a half inches in length and quite shallow was found on the diaphragmatic surface, almost opposite the hilum. In attempting to determine the extent of this rupture a free hemorrhage was started up. Owing to difficulty of access and the friability of the organ, tamponage rather than suture was deemed most expedient. The hemorrhage was easily controlled by a light gauze tampon, carried out through the upper end of the primary incision. The abdomen was closed in the usual manner. The tampon was removed at the end of 48 hours. The patient made a good and uninterrupted recovery, with the exception of a high postoperative temperature, reaching 105 on the third day, and dropping to normal on the fourth. He was discharged from hospital April 12, 1910.

CASE II.—R. G., case No. 34,260, Spaniard, male, age 31, white, occupation, laborer, on Isthmus 5½ years, admitted to Colon Hospital August 6, 1911, at 7.30 P.M.

Past History.—One previous admission to hospital (Ancon, 1905, with yellow fever). Has never had typhoid or dysentery.

Has had several mild attacks of "fever." Denies venereal or alcoholic history.

Present Illness.—Was taken sick August 2 with chill, fever, intense headache, vomiting, and pain in umbilical region. Continued at work until August 4, though suffering daily with fever. He has sustained no injury.

Physical Examination.—Patient fairly well nourished, though slightly anæmic. The abdomen showed distention and slight rigidity, with decided general tenderness, more marked around the umbilicus. Spleen palpable at costal margin. Heart and lungs negative. Tongue coated. No icterus. Urine shows slight trace of albumin; no casts or sugar. Blood examination was positive, showing a moderately heavy æstivo-autumnal infection. Leucocytes 8,400; stool examination negative.

Case History.—The temperature on admission was 100.5° F. Pulse 120. Respiration 20. Routine quinine treatment, grains 15 t.i.d., was instituted. The following morning the temperature dropped to 99° and the patient seemed very comfortable. At 8 P.M. the temperature rose to 101° and the patient complained of increasing abdominal pain, centring about the umbilicus and radiating toward McBurney's point. The following morning (August 8) there was marked abdominal rigidity and tenderness, with nausea and vomiting. The abdomen was distended and dulness was noted in both flanks. Leucocyte count 17,400. The patient was transferred to the surgical side with a diagnosis of general peritonitis of unknown origin.

Operation (August 8, 10 A.M.) (Dr. Noland).—Ether anæsthesia. Right rectus incision. The abdomen contained approximately 1,500 c.c. of dark fluid blood with few clots. A search for the source of the hemorrhage revealed a shallow rupture on the convex surface of the spleen, some two inches in length, extending backward from the anterior border about one inch above the anterior basal angle. A cauliflower-like mass of blood-clot protruded from the rupture. Palpation gave the impression of extensive infiltration beneath the splenic capsule. The spleen was enlarged to about one and one-half times the normal size. There were no adhesions. Apparently all hemorrhage had ceased, and no further bleeding resulted from manipulation. The abdomen was sponged relatively free of blood;

the appendix, which was adherent and markedly thickened, was removed, and the abdomen closed in the usual manner. There was a postoperative temperature rise to 104° on the day following operation, with a gradual decline to the normal, which was reached on the fourth day. The patient made a good recovery and was discharged on August 27, 1911. Smears of the free blood in the abdomen, made at operation at the suggestion of Dr. J. P. Bates, showed a very heavy æstivo-autumnal infection.

CASE III.—S. W., case No. 36,690, Jamaican, black, male, age 24, occupation, laborer, on Isthmus 4 months, residence Camp Totten, near Gatun. Admitted to Colon Hospital December 16, 1911, at 8 P.M.

Past History.—Has had four attacks of "fever," although this is his first admission to hospital. Denies venereal and alcoholic history. With the exception of the attacks of "fever" referred to, his health has always been good.

Present Illness.—On the day of admission, while taking his usual midday rest, he suddenly felt a severe pain in his abdomen, most intense in the region of the umbilicus. He describes his pain as being of a sharp and lancinating character, with radiation upward and to the left, being quite severe beneath the costal margin. Respiration increases his discomfort. Soon after the onset of pain he vomited and complained of feeling intensely weak. His bowels moved on the morning of the day of admission. He had been feeling quite well and had worked all morning. No history of injury or strain could be obtained.

Physical Examination.—Patient well developed and well nourished. Facies anxious. Severe pain and discomfort plainly evident. Heart and lungs negative. There was some distention of the abdomen, particularly above the umbilicus. Abdominal tenderness and rigidity were marked. Dulness was elicited in each flank, being slightly more pronounced on the left side. Leucocytes 24,000. A catheterized specimen of urine showed a faint trace of albumin, but no casts and no sugar. The temperature on admission was 99° F. Pulse 100. Respiration 26 and restrained. General condition of the patient was fairly good. A definite diagnosis before operation was not made, although it was thought that there was probably a perforation of some hollow viscus with a rapidly-spreading peritonitis or

slow hemorrhage. The condition was plainly acutely surgical, and immediate operation was decided upon.

Operation (December 16, 9 P.M.) (Dr. Watson).—Ether anæsthesia. A right rectus incision was employed on account of its giving opportunity for a thorough exploration, although the symptoms were slightly more pronounced in the epigastric and left hypochondriac regions. Upon opening the peritoneum there was a gush of bright red blood, estimated as at least 1,000 c.c. A search for the cause of the hemorrhage revealed a shallow laceration on the convex surface of the spleen, slightly below the midline and extending entirely across the organ. Numerous large clots surrounding the spleen were removed and the hemorrhage easily controlled by a light gauze tampon. The patient left the operating room in good condition, pulse 104, regular, good quality. Continuous salt solution per rectum was retained well. The condition of the patient for 24 hours following operation was encouraging, except for the fact that only nine ounces of urine were excreted. Complete suppression followed. The patient died at 1.30 A.M., December 19, 52½ hours after operation. An autopsy by Dr. R. B. Hill, 8 hours after death, showed a very small amount of free blood in the peritoneal cavity, with several large clots in the left hypochondrium. The spleen, when removed, weighed 140 grammes. Opposite the hilum on the convex surface of the spleen there was a superficial tear extending transversely a distance of three inches. Beneath the capsule, and separating it from the gland, there was considerable clotted blood. Smears made from various parts of the splenic pulp were stained and æstivo-autumnal parasites demonstrated. (Repeated examinations of the peripheral blood before death were negative.) The right kidney was small, its cortex was thin, and scattered through the parenchyma were a few small cysts filled with clear, straw-colored fluid. The capsule stripped with a slight degree of resistance, exposing a somewhat granular surface. The left kidney showed similar changes. Opposite the hilum on the convex border there was a cyst the size of a large hen's egg, containing clear, straw-colored fluid. The bladder was empty. The heart showed a moderate degree of hypertrophy. There were a few fibrous adhesions in each pleural cavity. All other organs were normal.

Etiology and Pathology.—Lidell, quoted by R. C. Bryan,[5] in his very able monograph on spontaneous rupture of the spleen in the course of typhoid fever, states that the causes of spontaneous rupture seem to be several. "(1) Softening of all the structures of the organ, including the coats of the blood-vessels; (2) intense congestion of the portal vein and radicles that occurs in the early stages of typhoid as well as malarial fever; (3) stagnating blood distending the soft walls of the blood-vessels in the splenic surface, thus forcing blood between the spleen tissue and capsule and investing peritoneum; (4) blood increasing compresses the parenchyma on one side and dilates the capsule and peritoneum on the other."

The above, as a whole, would seem to be a plausible theory in regard to the cause of spontaneous rupture of the malarial spleen. We are inclined to believe, from the evidence afforded by our small series of cases, that rupture of the splenic capsule is secondary to rupture of the engorged capillaries, with hæmatoma formation and consequent increased tension. In Case III there was marked extravasation of blood between the capsule and parenchyma over a considerable area. Case II, at operation, showed a cauliflower-like mass of blood-clot protruding from the rent in the capsule, and palpation over the entire convex surface of the organ gave the impression of extensive infiltration beneath the capsule. In a fairly extensive series of cases of traumatic rupture of the spleen we have never observed infiltration of this character. It would seem that the spleen does not necessarily have to undergo an enormous degree of enlargement for spontaneous rupture to occur. In none of our cases was the organ enlarged to more than twice its normal size. The marked thickening of the capsule and the increased amount of connective tissue in the parenchyma would seem to offer an explanation of the comparative rarity of spontaneous rupture of the large "ague-cake," so frequently observed in the tropics. As to the situation of the tear, Cantlie[6] calls attention to the frequency of rupture on the visceral (internal) surface in malarial spleens, the result of trauma. It is interesting to note that in the spontaneous ruptures observed by

us the tear in each instance was located on the diaphragmatic (convex) surface.

Symptoms and Diagnosis.—The symptoms of spontaneous rupture correspond closely with those commonly observed in traumatic rupture. The absence of a history of injury in the spontaneous ruptures, together with their decided rarity, renders the diagnosis much more difficult. Severe abdominal pain, slightly exaggerated above and to the left of the umbilicus, general abdominal tenderness with marked rigidity of the abdominal muscles and some degree of dulness in the flanks, together with a history of previous malarial attacks, or the presence of malarial parasites in the peripheral blood, should lead one to suspect spontaneous rupture. Symptoms of shock and collapse may develop if the tear is extensive and the consequent hemorrhage rapid and severe. Fixed dulness in the left flank, with progressive enlargement of the area of dulness (Ballance's sign) if present, would be pathognomonic of splenic rupture. The symptoms are at times confusing, but even in cases in which the hemorrhage is not sufficiently severe to make an early positive diagnosis easy the indications for immediate exploration are usually unmistakable. The treatment is strictly surgical. Although spontaneous recovery may occur, as noted in Case II, in which the hemorrhage had entirely ceased at the time of operation, such a favorable outcome should not be expected in all cases. The treatment of the rupture will depend upon its extent and location. Splenectomy, we believe, should be reserved for the more extensive lacerations, and cases in which conservative measures for the control of hemorrhage fail. Suture of the congested and friable spleen is always difficult and, at times, impossible. Tamponage, as a means of controlling hemorrhage, has given quite satisfactory results in our cases of spontaneous as well as traumatic rupture. The after-treatment is that of any abdominal section.

CONCLUSIONS:

First.—That spontaneous rupture of the malarial spleen occurs in rare instances.

Second.—That the spleen does not necessarily have to undergo a great degree of enlargement for spontaneous rupture to occur.

Third.—That very deep palpation or forcible percussion of the enlarged malarial spleen should be avoided.

Fourth.—That exploratory puncture of the spleen for diagnostic reasons is not without danger.

Fifth.—That the treatment of spontaneous rupture of the malarial spleen is surgical, and that early operation is indicated in all cases in which the condition is suspected.

We desire to thank Col. W. C. Gorgas, Chief Sanitary Officer, Isthmian Canal Commission, for permission to publish this paper.

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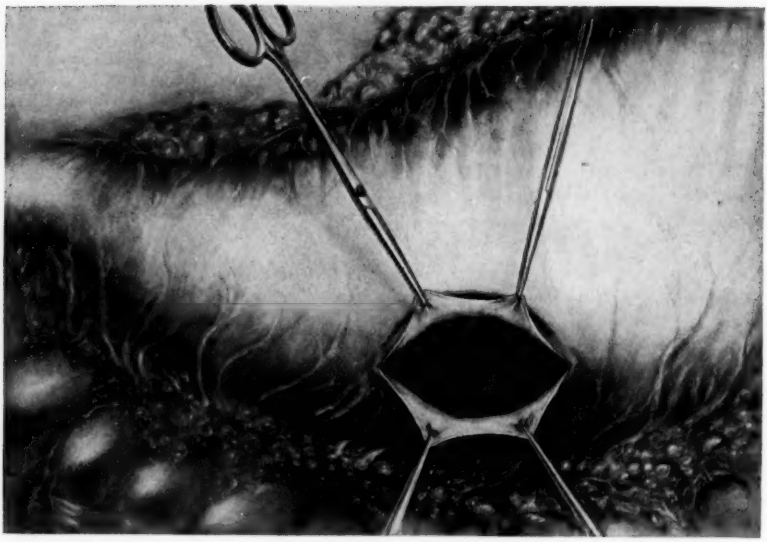
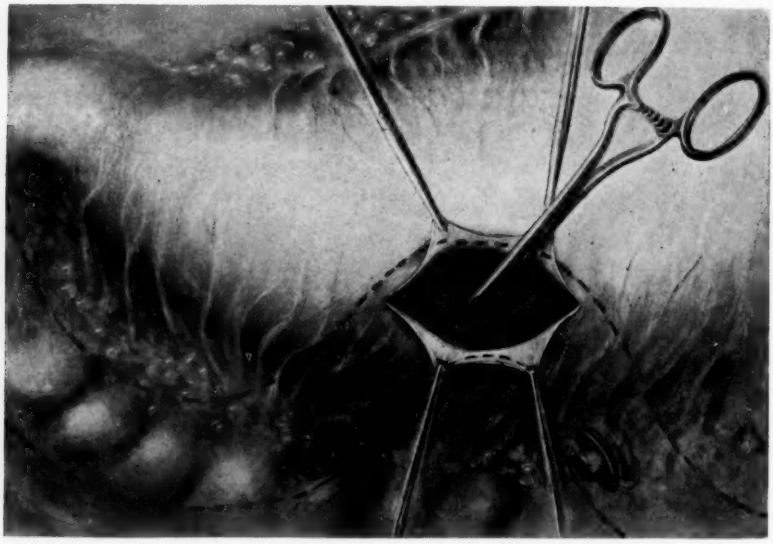
FIG. 1.



The incision in the anterior wall of the stomach allows access to the gastro-enterostomy opening in the posterior wall.

FIG. 2.



The two halves of a Murphy button have been introduced by the transgastric route, caught the two portions of bowel contiguous to the gastro-enterostomy opening and will be telescoped in order to short-circuit the loops for the treatment of vicious circle.

THE USE OF A MURPHY BUTTON TO EFFECT DUODENOJEJUNOSTOMY AFTER GASTRO-JEJUNOSTOMY.

BY WILLARD BARTLETT, M.D.,
OF ST. LOUIS, MO.

NOTHING can distress patient and operator more than persistent vomiting of bile following a gastrojejunostomy. This condition is rarer than formerly, but does occur, although the improved technique of the higher operation has made it less frequent; however, a remedial entero-enterostomy is made more difficult when a vicious circle complicates the higher operation than was the case when a long loop was present.

I have attempted on rare occasions several methods of relieving this unfortunate condition, but have experienced great difficulty with every means except the one described herein.

In a recent case, in which I operated, February 28, 1912, there followed vomiting of bile, which persisted until April 16, 1912. On the latter date the abdomen was reopened and the field found to be deeply placed, fairly well fixed, and with practically no loop.

I was forced to devise a method of short-circuiting the duodenum, which I did in the following manner:

After exposing the stomach, an incision was made in the anterior wall of this structure (Fig. 1), allowing access to the gastero-enterostomy opening in the posterior wall.

With a hysterectomy clamp, one-half of a Murphy button was introduced through the opening in the posterior wall into the duodenum (Fig. 2), then the other half of the button was introduced into the jejunum. Two small incisions were made through the intestinal wall, exposing the neck of each half of the button.

Then the two portions of the bowel contiguous to the gastro-enterostomy opening in which the halves of the Murphy buttons had been placed were brought together and a short

circuit established by telescoping the two halves of the button.

I have found this method extremely easy to accomplish, the only difficulty experienced being in protecting the field with packs.

Following the operation, the patient vomited only once before leaving the hospital, and that a few hours after operation.

ILEUS DUE TO MECKEL'S DIVERTICULUM.

BY ARTHUR BARNETT EUSTACE, M.D.,

OF CHICAGO.

THERE are, no doubt, numerous cases of ileus due to Meckel's diverticulum which are not reported, and, consequently, will not be found in the literature. If these cases are not compiled and published, how shall we be able to arrive at a logical conclusion as to their relative frequency and the different manners in which they may occur?

With the above foreword as a stimulation to others, I herewith submit the data of a case of ileus due to a Meckel's diverticulum in which there were present a volvulus of the diverticulum itself and an obstruction of the ileum produced by it.

H. B., age 11 years, a school-boy, was first seen by me on August 16, 1912, and gave the following clinical history: That he had always been in perfect health until the previous ten days, at which time he was taken with severe cramps in the abdomen, during the duration of which he could not walk nor move without increasing their severity. The first attack of "cramps" was associated with vomiting, and lasted for four or five hours, and were relieved upon his going to bed. A second attack followed three days later, and the cramps and vomiting were more marked than the first. The boy noted that his bowels did not move during this period of "cramps," but moved freely after the cessation of the second attack. The pain and discomfort disappeared without any other symptoms developing.

The boy remained perfectly well for seven days, and at 10 P.M. on the night of August 15 was taken with "terrible cramps" in the abdomen, and a few hours later started vomiting at frequent intervals during the night; the vomitus is described as being black and having a most disagreeable odor.

I first saw the child twelve hours after the onset of this attack, and examination revealed the following: The patient lay in bed

with his legs drawn up, and stated that it relieved the severity of the pain. He complained of pain all over the abdomen, but most marked about one and one-half inches above McBurney's point. The abdomen was markedly distended, and a marked rigidity of the recti muscles, especially the right side, was noted.

The entire abdomen was markedly tender, especially just above McBurney's point. His temperature was 99.8° F. and his pulse 132. Leucocyte count, 17,800.

A diagnosis of acute appendicitis, with possible perforation, was made, being based upon the sudden onset with pain and vomiting and the well-localized tenderness and rigidity, and immediate operation advised. The patient was taken to the hospital within an hour and the following operation made. An effort was made to clear out the lower bowel with a rectal enema just before the operation, with a fair result.

A right rectus incision was made and a large amount of serous fluid escaped when the peritoneal cavity was opened. The peritoneum was " fiery red " and covered with small deposits of fibrin.

Upon attempting to deliver the appendix into the wound a great deal of difficulty was encountered, and after several futile attempts it was decided to enlarge the incision in order to afford a better view of the abdominal contents.

The appendix was noted lying several inches above its normal position and bound down by many adhesions. It was freed and delivered into the wound and found to be perfectly normal except for a moderate injection of the vessels of the serosa.

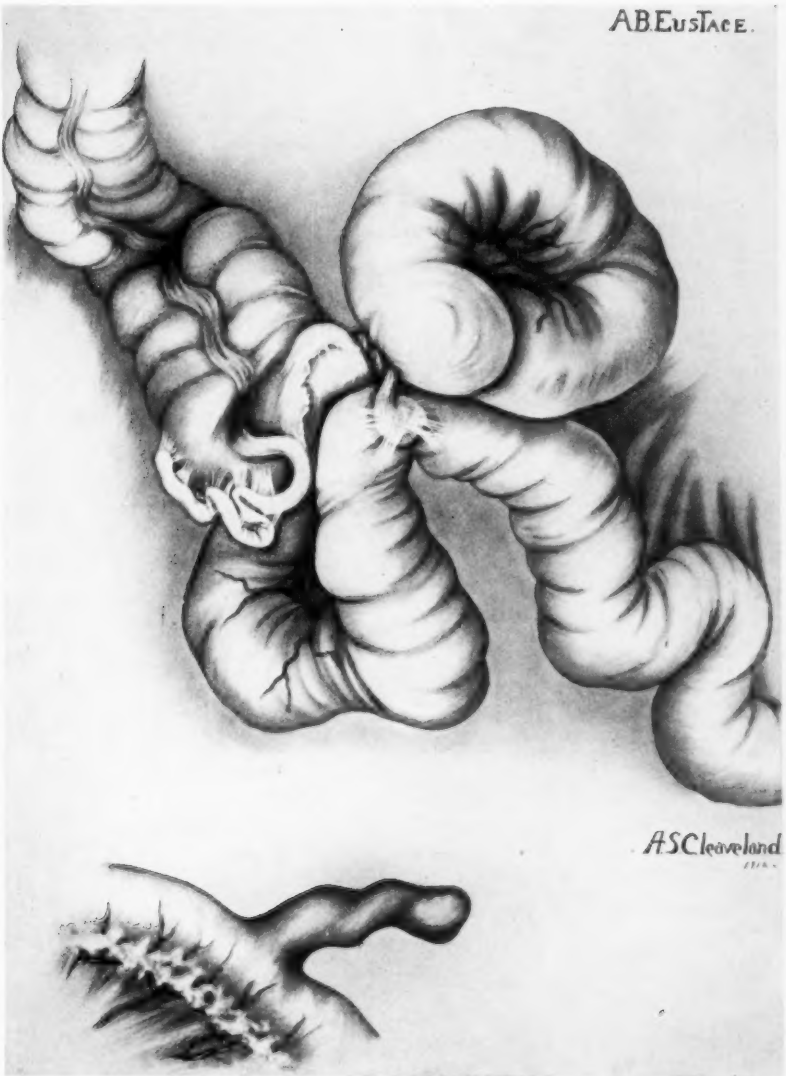
A marked dilation of a loop of ileum was then noted and an examination of the small bowel made. The ileum was carefully inspected, beginning at its junction with the cæcum, and the cause of the trouble found to be a Meckel's diverticulum located about 20 inches from the ileocæcal valve.

The diverticulum was 9 cm. long and about 3 cm. wide at the base, and tapered gradually to its tip, which was attached to the umbilicus.

The diverticulum was twisted upon itself like the coils of a rope, and was of a dark-brown color, and the normal glossy appearance of a normal serosa had given way to a rough hazy one. Thus we were able to demonstrate a distinct volvulus of the diverticulum itself (see Fig. 1).

A large loop of ileum was shown to be strangulated by the

FIG. 1.



Showing Meckel's diverticulum, causing strangulation of loop of ileum. Twisting of diverticulum shown in large and small drawing.

twisted diverticulum, as shown in the accompanying drawing.

The diverticulum was clamped and cut and the coils of bowel released. Examination of the strangulated portion of the ileum showed it to be in good condition and resection unnecessary.

The diverticulum was then removed by the same technique by which the appendix is usually removed—ligation, amputation, and invagination of the stump. A row of sutures was made over the site of removal to cover over some raw surfaces made by the tearing of adhesions.

The appendix was also removed and the abdomen closed. The patient made an uneventful recovery and left the hospital in 18 days.

Volvulus of Meckel's diverticulum is somewhat rare. When not associated with a strangulation of the bowel it may produce the signs of an acute diverticulitis, viz., pain, rigidity, nausea, and the gradual appearance of the signs of peritonitis.

A diagnosis of ileus due to Meckel's diverticulum seems to me to be impossible unless you have definite knowledge of a persistent umbilical fistula in infancy which may have healed, or an open diverticulum present.

The signs of obstruction due to a Meckel's diverticulum do not differ from those of obstruction due to other causes. A symptom-complex of an abdominal crisis as outlined above constitutes a clear indication for immediate surgical intervention.

EXTRASACCULAR HERNIA.

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EXTRASACCULAR or sliding hernia of the large intestine or bladder has had but little attention directed towards it, but of late years sufficient interest has been aroused in this condition to show that it is considerably more common than was at first believed. The lesion, when first seen at operation, is very puzzling, not only as regards diagnosis but also as regards the method of treatment. In fact, many methods have been adopted with the idea of preventing recurrence, with apparently but poor results. Thus Carnett,[6] in his valuable article on the subject, states that recurrences are very frequent, and Lockwood [17] goes so far as to say that the cases are very formidable and "prudence dictates that they should be avoided."

In the first case of this condition upon which I operated a simple method of closure of the sac was adopted, which on theoretical grounds seemed insufficient. A consideration of this case led me to devise a method of operating which I have been able to perform on three subsequent occasions. This method I believed at the time to be new, but, later, careful search of the literature has shown it to be only a modification of a method previously advocated. The good results following the use of it have, however, led me to publish these cases, so that further attention may be directed towards this condition. The first of the four cases is as follows:

CASE I.—A. N., a male, aged 46, stated that 12 years ago he first noticed a swelling in the right inguinal region. It came on during an effort with considerable pain, and has been steadily increasing in size since. On examination he was a poorly-de-

veloped man, with weak abdominal walls. There was a large right inguinal hernia passing along the whole length of the inguinal canal which was only reducible in part. There was nothing else of note in his condition.

Operation (November 8, 1909).—A 4-inch incision was made over the right inguinal canal, the aponeurosis of the external oblique cleared and divided. The sac was found opened, and a coil of small gut with a portion of omentum reduced. It was then noticed that the cæcum was projecting into the postero-external part of the sac so that its anterior surface was alone covered with peritoneum. About one inch of the cæcum projected from the abdomen. The sac was freed as far as possible, the redundant portion removed, and the opening closed with a continuous suture. The cæcum and attached peritoneum were then pushed back into the abdomen and the conjoint tendon sutured to the deep surface of Poupart's ligament over the cord after the manner of Macewen,[19] sharp curved needles and chromic catgut sutures being used.

The wound healed well, and he was discharged three weeks later.

At the present date, in answer to inquiries, he states that the pain and swelling have returned, but to a less degree than previously.

The above operation seemed at the time insufficient, for not only was the cæcum inadequately reduced, but even when the excess of sac was removed a distinct pouch was kept which was simply pushed back into the peritoneal cavity, the attempt at a radical cure resting wholly upon the repair of the muscular wall, a method which has frequently been shown to be inadequate, and recurrence, as took place in this case, being probable. It seemed necessary to free the cæcum before replacing it, as well as to overcome any dimpling of the peritoneum at the site of the sac. I therefore devised the following operation:

The usual incision having been made, the aponeurosis of the external oblique is slit up in the line of its fibres and the sac laid bare. This latter structure is carefully freed from the surrounding structures of the cord and opened at the fundus. The opening is enlarged along the anterior surface of the sac

so that the contents are freely visible. The condition then seen will be that depicted in Fig. 1. The sac is now divided with scissors on the posterior aspect to within one-half inch of the caput cæci, the incision being then carried along either side of the cæcum as far as the neck of the sac and at a distance of one-half inch from the lateral walls of the cæcum (Fig. 1). On pulling the cæcum forward two flaps of peritoneum are thus seen (Fig. 2), which are sutured together so as to surround the bare posterior surface of the cæcum, and the two edges of the divided sac are also sutured together behind the cæcum. This latter structure now lies free in the sac and can readily be reduced into the abdomen. The sac, being restored, can be invaginated and pushed through the internal oblique by Kocher's [16] second method. By this means the neck of the sac, with the attached part of the cæcum, is pulled up well away from the internal ring, while the freed cæcum is returned to the abdominal cavity. The muscular and aponeurotic wall is then carefully restored.

The three cases in which this operation was carried out were as follows:

CASE II.—W. M., aged 36, stated that four years ago he noticed a swelling in the right groin. His attention was first directed to it by the presence of pain while lifting a heavy weight. The swelling has been increasing since, but is lessened when he lies down. He has never worn a truss. On examination a right inguinal hernia was seen which was only in part reducible. The abdominal muscles were well developed.

Operation (December 10, 1910).—The cæcum alone was found in the sac and was in part extrasaccular, the posterior wall being bare. An operation on the above lines was carried out, and the conjoint tendon sutured over the cord to the deep surface of Poupart's ligament with chromic gut. Three months later he returned with a hydrocele of the right tunica vaginalis, for which an operation was performed. The site of the hernia was in perfect condition. At the present date he writes to say that he has never had any return of the pain or swelling and is able to carry on his work as a dock laborer in perfect comfort.

CASE III.—F. P., a male, aged 30, stated that he noticed the sudden onset of pain in the right inguinal region two years ago while carrying a heavy weight. Soon afterwards he noticed a swelling, which has steadily increased in size. He has never worn a truss. On examination there was seen a large right inguinal hernia which passed down to the top of the testis. The testis was small and atrophic. A thick-walled sac could be felt.

Operation (September 5, 1910).—The sac was large and the upper part contained a large mass of omentum and a portion of cæcum corresponding in size and position with the last case. An operation was carried out on the above lines and the muscular canal restored. At the present date he writes that there has been no return of any pain or swelling. He has not worn his truss since operation, and has returned to his usual work.

CASE IV.—L. N., a male, aged 68, stated that he had a rupture for fifteen years, for which he had always worn a truss. For four weeks there had been pain in the swelling, and for seven days this had been severe. He had been unable to completely reduce the hernia for six months. On examination there was a large left inguinal hernia which was only partly reducible, his general condition was poor, and he showed signs of two previous attacks of right-sided hemiplegia, but owing to the amount of pain operation was decided upon.

Operation (April 4, 1911).—On opening the sac a loop of large intestine was seen, the upper two inches of which had no mesentery, the gut, which was evidently iliac colon, being in this position partly extrasaccular. An operation on the above lines was carried out. Convalescence was uninterrupted, and at the present date he writes to say that he has never had the slightest trouble with the hernia since operation, and has not used his truss since.

It will be seen, therefore, that in the first case, with simple closure of the sac, reduction of the gut, and suture of the muscles, there is a definite return of swelling and pain. In the three cases treated by the more complete method there is no trace of any recurrence, although one patient is 68 years of age, and the other two have returned to hard work for a period of nearly two years.

In the case of an extrasaccular hernia of the bladder a simi-

lar operation can be done, but in this case the bladder is pulled outside the sac before the edges are sutured. An incision in this case is made on the inner and posterior walls of the sac close to the prolapsed bladder and continued on either side of this viscus up to the neck of the sac (Fig. 1). The sac is now pulled forward and the bladder backwards and the edges of the sac sutured together (Figs. 6 and 7). By this means the bladder is left wholly without the sac, which is invaginated in the usual way. The freed bladder is now returned beneath the muscles into the cave of Retzius and the muscular and aponeurotic wall of the abdomen firmly repaired. The following is a case treated in this manner:

CASE V.—P. C., a male, aged 44, stated that ten years ago he first noticed a swelling in the right inguinal region which came on during an effort and was associated with considerable pain. It has been steadily increasing in size since. Eight years ago he first noticed a swelling at the upper part of the umbilicus, which has also slowly increased in size. On examination, a stout man with a large, prominent abdomen. There is a small hernia at the upper part of the umbilicus which is not wholly reducible. There is also a large right inguinal hernia which is wholly limited to the lower part of the inguinal canal and therefore appears to be direct. It passes only part of the way down the scrotum, and is reducible in greater part, but not wholly.

Operation (January 6, 1910).—A transverse elliptical incision 4½ inches long was made round the umbilicus and this hernia repaired according to the method advocated by Mayo.[21] A 4-inch incision was then made in the right inguinal region, the aponeurosis of the external oblique being cleared and slit up. A large sac was seen in the position of the external ring. It was covered with a thin aponeurotic layer, which was seen to be the stretched conjoint tendon, through a well-defined opening of which the hernia escaped. Below and internal to the sac a large pouch of bladder was found to be attached. The rest of the operation was carried out on the lines described above. The opening in the conjoint tendon was sutured with chromic catgut. The conjoint tendon was also sutured to the deep surface of Poupart's ligament, over the cord, after the method of Macewen,[19] an ordi-

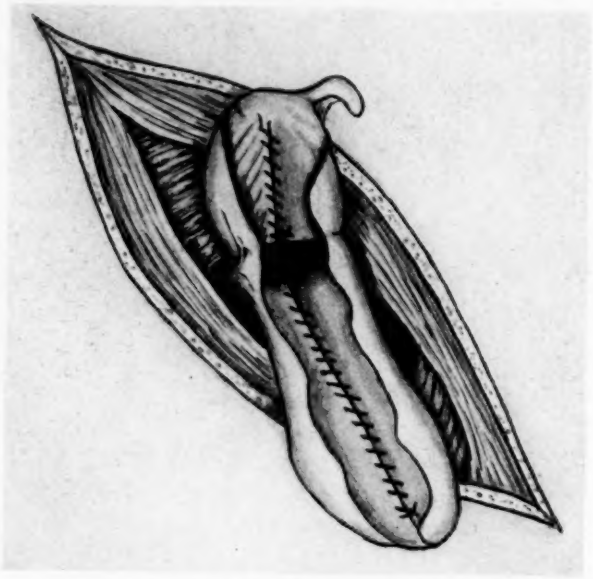
FIG. 1.

Sac laid open to show position of cæcum with lines of incision. (An excessive amount of the anterior wall of the sac has been removed to show details.)

FIG. 2.

Cæcum pulled forward to show peritoneal flaps.

FIG. 3.

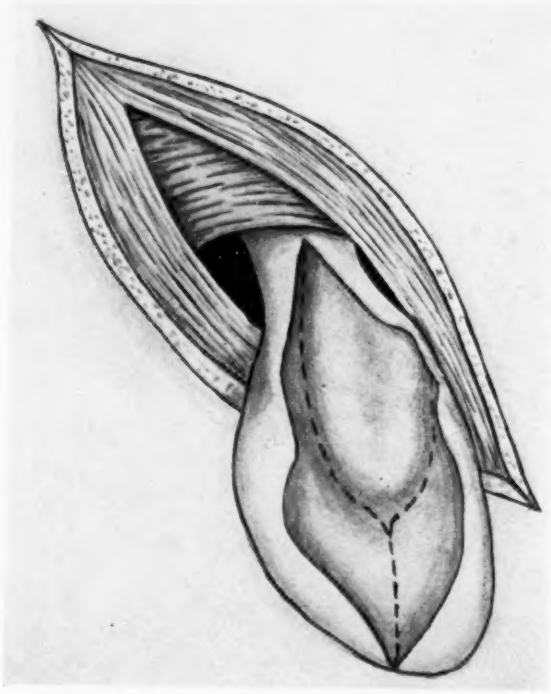


Suture of peritoneal flaps on cæcum and restoration of sac.

FIG. 4.

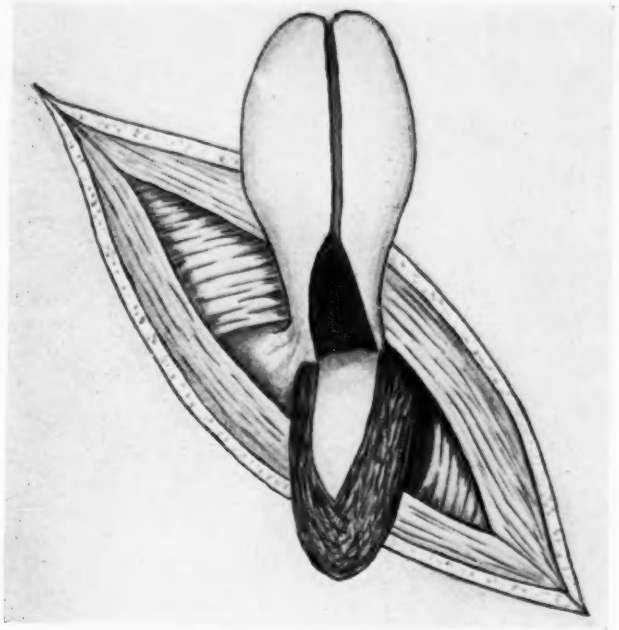
Freed cæcum reduced. Commencing invagination of reconstructed sac.

FIG. 5.



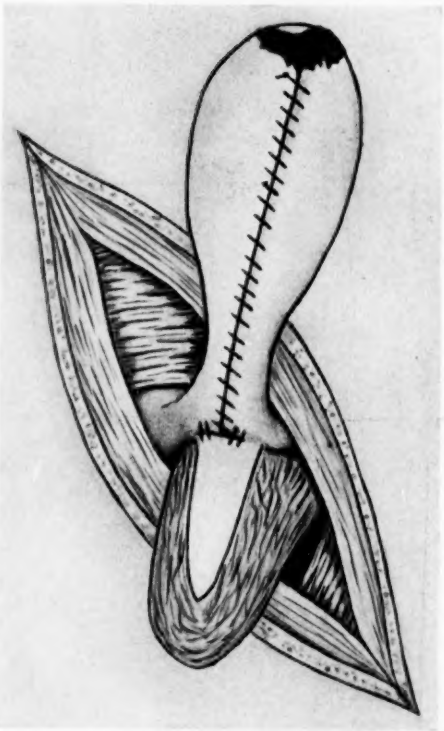
Sac laid open to show position of bladder. Line of incision indicated.

FIG. 6.



Bladder pulled downward and sac upward.

FIG. 7.



Sac reconstructed and ready to be invaginated. Bladder freed, displaced outside sac, and ready to be returned to cave of Retzius.

nary sharp-curved needle being used. The wound healed well and he was discharged three weeks later. In answer to inquiries he states that at the present date he has no trouble with either hernia and is able to carry out his usual work in comfort.

Extrasaccular herniæ are those in which some portion of the wall is formed by a viscus which in its normal position is only in part covered by peritoneum. It is thus seen that this viscus, in the inguinal or femoral region, may be either bladder, cæcum, or iliac colon.

Hernia of the Bladder.—This condition is now recognized as being a very common complication of both femoral and inguinal herniæ. Although it has been known for many years and was, in fact, mentioned by Albucasis in the twelfth century, and Guy de Chauliac described the passage of a catheter as an aid to diagnosis in 1363, yet its frequency has only of late been appreciated. In the extensive article on hernia by Birkett,[3] in 1883, there is no mention of this condition. Cases of the presence of the bladder in an inguinal hernia were, however, described by Cloquet,[7] and in 1889 Lockwood[17] mentions a case where the bladder was injured in drawing down the sac to ligature it. Within the next few years the condition became well recognized, and in 1900 McAdam Eccles[18] stated that it was probably associated with nearly 1 per cent. of inguinal herniæ. He described three varieties.

I. With peritoneal covering. These occurred within the sac of a large inguinal hernia, and through a greatly dilated, deep abdominal ring.

II. Where the bladder forms part of the wall of the sac. This is the commonest variety, the bladder being situated on the inner wall and having only a partial peritoneal covering.

III. Where the bladder descends without any peritoneal covering whatever.

This classification is maintained to-day, although there is some doubt as to whether it is ever possible to find a hernia consisting of bladder alone, it being generally considered that a peritoneal sac, though often small, is always present.

The cause of the presence of the bladder appears to be undoubtedly that this viscus is dragged downwards by the peritoneum in the formation of the sac. The sac is generally large and the hernia of old standing. It must be remembered that the peritoneum is firmly attached to the posterior and superior surfaces of the bladder, and thus as the sac increases at the expense of the parietal peritoneum it will gradually come to drag the attached bladder with it, and thus a portion of this viscus will come to form the inner and posterior wall of the sac. In many cases an early stage of this condition may be seen; that is to say, the extraperitoneal fat which surrounds the bladder is often seen to occupy the position which the bladder, if prolapsed, would attain to, although so far the bladder is still within the abdomen.

This explanation, although undoubtedly referring to the great majority of these herniæ, does not seem to make clear those rare cases in which a small peritoneal sac is alone present, or those in which the bladder is present within the sac. These latter do not come within our present consideration, but the former may be explained by the suggestion put forward by McAdam Eccles [18] and supported by Sir B. G. A. Moynihan,[26] namely, that the bladder is dilated and hypertrophied by obstruction from a stricture or an enlarged prostate and thus may come to overlie the opening of the abdominal ring.

The presence of the bladder in femoral herniæ seems to have been recognized even more lately. No mention of the condition is made by Birkett [3] or Lockwood.[17] McAdam Eccles [18] states that on several occasions this viscus has passed into a femoral sac. Moynihan [26] carefully investigated the condition and collected twenty-nine cases, two of which were males and twenty-seven females. Since then a very large number of individual cases have been recorded, and, as Erdmann [8] mentions, it is now recognized that the bladder is more commonly prolapsed in this type of hernia than in the inguinal variety.

The bladder will be situated on the inner side of the sac wall, and the cause of its presence will be similar to that of the inguinal type.

Symptoms.—The symptoms of the presence of the bladder are often ill defined, and in the majority of cases this viscus is only found at operation, the condition having been previously unsuspected. Such herniæ are, however, large and always irreducible in part, so that the fact that the patient has a relatively large hernia which is reducible in part only should raise the suspicion that the bladder is associated with a part of the sac wall.

In other cases more definite signs and symptoms may be present. According to McAdam Eccles,[18] it may be possible to discern a fluctuating swelling in the hernial region which swelling is dull on percussion. Micturition may take place in two stages: the bladder is emptied and then by some movement the urine passes out of the hernial portion and is expelled, the tumor at the same time being noticed to disappear. In other cases pressure upon the hernial sac may be associated with a marked desire to micturate, as in a case recorded by Noall.[27] In such cases artificial distention of the bladder may be followed by an increase in size of the hernial swelling.

Even at operation the condition is not always easy to diagnose. The muscular fibres of the bladder wall are in large part covered by and infiltrated with fat, so that there is a danger of the condition being mistaken for the extraperitoneal fat alone, so that most surgeons have seen or heard of cases in which the viscus has been either inadvertently opened at operation or injured while the neck of the sac was being closed, an accident which is not uncommonly followed by fatal results. When once the frequency of the condition is realized, however, the presence of a considerable mass of tissue in this situation will at once give rise to the suspicion that the bladder is present. A finger inserted inside the opened sac will enable the amount of this tissue to be more readily estimated, and it may be determined thereby that it forms part of a hollow viscus. If any doubt should still remain, it would be possible to make the condition certain by injecting fluid into the bladder through a catheter.

The treatment will depend upon the amount of bladder

which is prolapsed. If small, this may be separated from the sac as high as the neck of the latter, which is then dealt with in the usual manner. The prolapsed portion of bladder which is now quite free is pushed back into the extraperitoneal space and the opening in the muscular and aponeurotic portion of the abdominal wall firmly closed. If larger, such a procedure might be associated with considerable injury to the bladder wall. It is therefore wiser to cut the free portion of the sac away from that attached to the bladder and then restore and treat the sac in the manner already described.

Hernia of the Cæcum.—The presence of a portion of the cæcum in association with a hernial sac has also had more attention devoted to it of late. Cases were, however, figured by Scarpa [31] in 1814. Mitchell Banks [23] described the condition fully and first made use of the term now so commonly used of landslip of the cæcum.

In the case of this viscus the relationships are complicated by the varying attachments of the peritoneum to the cæcum when this latter is situated in its normal position. Thus of the five cases described by Lockwood [17] the cæcum in four retained in its entirety its serous covering, but in the fifth it was partially denuded. Tuffier [36] has described a case in which there was no trace of a sac, but Treves [35] states that in all cases a sac is present, although in many such it may be very small.

The developmental changes occurring in and around the cæcum throw considerable light upon the presence of these different types. The cæcum develops as a small diverticulum as early as the end of the first month of fœtal life (Bryce [5]); that is, before the axial rotation of the gut is complete and while there is still a common mesentery. It thus happens that the cæcum itself, which is usually about two and a half inches long, has a complete covering of peritoneum and has no mesentery attached to it, but lies free in the peritoneal cavity.

In early embryonic life the whole of the large gut has one common mesentery, which persists until the seventh week, when axial rotation of the U-shaped loop takes place, by which means the cæcum is carried over to the right side of the abdomen.

CÆCAL HERNIÆ.

FIG. 8.

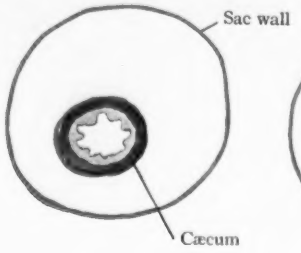


FIG. 9.

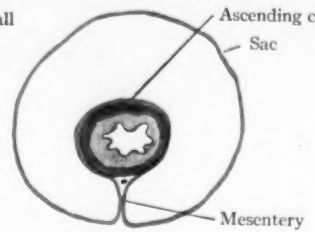
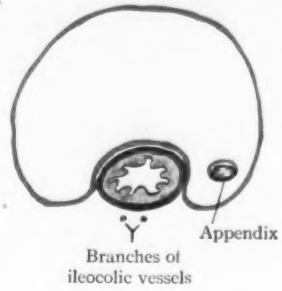


FIG. 10.



COLIC HERNIÆ.

FIG. 14.

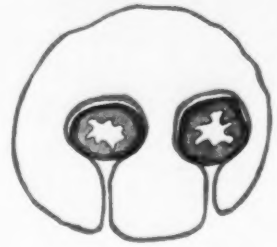


FIG. 11.

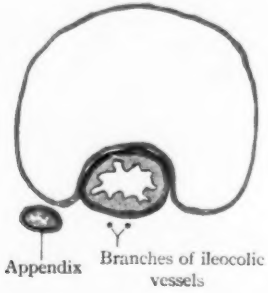


FIG. 12.

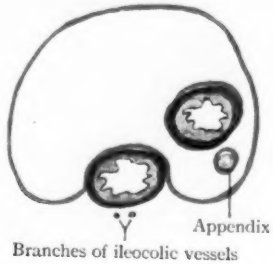


FIG. 13.

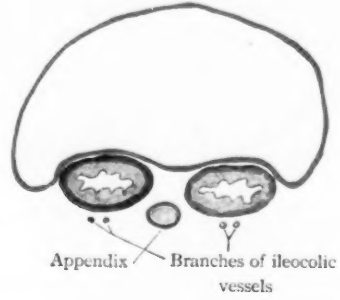
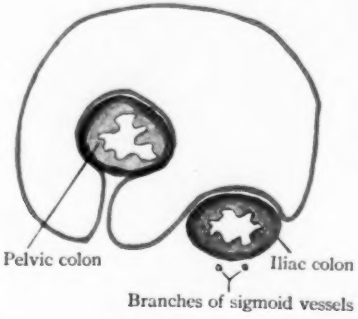


FIG. 15.



At this stage then the ascending colon has a well-defined mesentery, while the cæcum forms a free diverticulum covered with peritoneum. The ascending colon now falls over to the right, so that the lateral aspect of its mesentery comes to lie in contact with peritoneum covering the posterior abdominal wall. These two layers then fuse and become absorbed, so that the peritoneum comes to be directly reflected off from the cæcum onto the posterior abdominal wall, and the usual condition in one of only a partial covering of peritoneum for the ascending colon, while the cæcum is free. In a small number of cases the colon may retain its mesentery, and Carnett [6] states that always in the newly-born, and usually in the adult, the two adherent layers can be separated and the primitive mesocolon reëstablished.

As the cæcum falls over to the right the appendix may get caught between the two layers and come to occupy an extraperitoneal position (Keith).[15] In addition to these changes, the ascending colon may, after fusion has taken place, again develop a mesentery, in its lower part at least, probably by stretching of the peritoneal folds. In a certain proportion of cases—according to Jonnesco,[14] 8 per cent.—the cæcum may in its upper part undergo changes similar to those of the ascending colon, so that it also may be in part uncovered by peritoneum.

A consideration of the above factors makes it clear that many different varieties of hernia of the cæcum may take place, and, as Sobotta [33] has shown, the cæcum, when distended, lies in contact with the anterior abdominal wall, so that its appearance in the sac of an inguinal hernia is not unlikely. Although most common in an inguinal hernia, this viscus may also pass through the femoral opening. The statistics of Hildebrand [11] and Gibbon,[12] combined by Carnett,[6] showed 164 inguinal and 21 femoral varieties.

The condition found at operation will, of necessity, be of one of the three following types:

I. *Simple Hernia.*—Here the cæcum has descended into the hernial sac in a manner identical with any coil of small gut (Fig. 8). In some cases only the appendix is present, as in

4 cases recorded by J. A. Macewen,[20] and while in this situation may even become acutely inflamed, as in cases described by Ewart.[9] In others the cæcum itself will also be prolapsed.

It will be seen that the condition may arise in one of three ways:

(*a*) From a persistence of the embryological condition of a mesentery to the ascending colon.

(*b*) From the presence of an acquired mesentery to the ascending colon.

(*c*) From the presence of a large cæcum or appendix, so that one or both are able to pass down into the sac, while the ascending colon maintains its normal position and relationships to the peritoneum.

The gut, in either case, is reduced with the same simplicity as the small gut, no difficulty arising in the operative treatment.

II. *Extrasaccular Hernia.*—This presupposes the presence of a sac, but the cæcum or ascending colon is either definitely outside the sac in part or the mesentery of these structures is firmly attached to a portion of the sac, so that simple reduction becomes impossible.

For such a condition to occur it is necessary that the cæcum slide down from its normal position. This sliding down of the cæcum may be due to congenital or acquired causes. The congenital are described as being two in number:

(*a*) In fœtal life a fold, known as the plica vascularis, is seen to run up from the mesorchium along the posterior wall, to end in the cæcum, appendix, mesentery, and ileum. Lockwood[17] regards the persistence of this fold as a developmental defect, and figures cases of cæcal hernia in which its presence was well marked. In one case in a child he was able to demonstrate gubernacular fibres passing up in this fold. He suggests that the testicle in its descent pulls upon the cæcum by means of this fold and thus drags downward the cæcum to form a hernia of this type.

(*b*) Adhesions may be formed between the posterior surface of the cæcum and the peritoneum covering the yet undescended testicle (Carnett).[6] The cæcum will then be dragged down with the subsequent descent of the testis.

The acquired condition is much the more common and is more comprehensible. Either there is a preliminary prolapse of the viscera on the posterior abdominal wall—in fact, a condition of enteroptosis, so that the cæcum lies at a lower level than normal and thus the retroperitoneal area lies in closer contact with the inguinal or femoral opening, and thus can easily prolapse through it—or, more commonly, a simple hernial sac is formed which enlarges, and, as it does so, drags down the peritoneum on the posterior abdominal wall. The cæcum, colon, and appendix, being firmly attached to this portion of peritoneum, are also dragged down and thus come to form the upper and posterior part of the sac.

That portion of the colon which in the abdomen was extraperitoneal will therefore come to lie outside the sac wall, the condition being then exactly comparable with that of an extrasaccular hernia of the bladder; but, as would be expected, prolapse of the bladder is more common in femoral herniæ, that of the cæcum in the inguinal variety.

In the majority of cases the cæcal hernia is found on the right side, but at times it is present on the left side, Foerster [10] being able to collect 54 cases. In most of such cases the cæcum was intrasaccular, and, indeed, it would be difficult to see how an extrasaccular hernia could occur in this position unless a condition of situs inversus were present.

Many different degrees of this type of hernia may be seen, but they may all be grouped under the three following headings:

(*a*) In this type there is a definite mesentery to the lower part of ascending colon, either of congenital origin or due to dragging upon the peritoneal attachments by the displaced cæcum. This mesen-

tery is attached to the posterior wall of the sac for a greater or lesser degree; thus reduction of the cæcum and colon becomes impossible unless the sac be reduced also. It will be seen that the branches of the ileocolic artery will enter between the two layers of this mesentery and thus will be running upon the posterior surface of the sac and therefore be liable to injury.

This variety, then, is characterized by the presence of a single piece of gut attached by a mesentery to the posterior wall (Fig. 9).

(*b*) In this variety there is no mesentery to the colon, this viscus having prolapsed through the ring while maintaining its normal extraperitoneal position; thus the sac will lie in front of the colon and only cover its anterior surface, the posterior surface of the viscus lying in direct contact with the posterior wall of the inguinal canal. The ileum, and generally the appendix, will maintain their normal peritoneal relationships, and thus will lie wholly within the sac, the relationships of the appendix depending upon its previous position with regard to the peritoneum while within the abdomen.

This variety, then, is characterized by the presence of a single piece of large gut which is only partly covered by peritoneum (Figs. 10 and 11).

(*c*) If the above condition continue to increase it will do so chiefly at the expense of the ascending colon. The mesenteric attachment of the lower part of the ileum appears to remain more or less fixed, so that the mesentery of the small gut has a relatively small attachment to the posterior wall of the sac. The ascending colon continuing to descend while the cæcum remains more or less fixed, a U-shaped

loop is formed which is composed wholly of large gut. According to Tuffier,[37] this condition may arise by the cæcum and colon descending to such an extent within the abdomen that the posterior surface of the colon comes to lie over the hernial orifice, and is thus the first structure to escape from the abdomen. It will be seen that the whole of this loop may be extrasaccular, or the cæcum may retain its normal relationships and thus lie within the sac covered by peritoneum, the colon alone lying without the sac.

The third type, then, is characterized by the presence of a U-shaped loop of large gut in part or wholly extrasaccular (Figs. 12 and 13).

III. *Sacless Hernia.*—This condition is very rare, and the explanation of the presence of the large intestine from the pull of a large sac would give no reason to believe that such a condition could occur. Sir F. Treves[35] even went so far as to state that a sac was always present. Cases, however, do undoubtedly occur in which there is no trace of a sac. One recorded by Tuffier[36] has already been mentioned, and Carnett[6] records another in which complete absence of any sac was made manifest by exploratory laparotomy. The description of Tuffier given above, that the primary condition is a prolapse of the cæcum and ascending colon, gives, however, a ready explanation of the occasional presence of such a lesion.

Ransohoff[29] has quite recently put forward an entirely new conception as to the cause of this type of hernia. He disagrees with the belief that the condition is due to sliding of the gut and posterior layer of the peritoneum. He believes that at first there is always a complete sac, and that the gut has become bound down by secondary adhesions which are similar to the adhesions, already described, which normally take place in embryonic life between the cæcum and the peritoneum of the posterior abdominal wall. Upon the amount of adhesions depends the size of the sac; if excessive, the sac may even be

obliterated. The proofs he brings forward seem, however, to be very incomplete. He believes that the condition cannot be due to sliding, because "even in the opened abdomen it is no easy task to strip the peritoneum from the abdominal wall, so close is its adherence, a statement with which I venture to think very few surgeons would be in agreement; while his remark that "a loop of intestine found in a hernial sac is conclusive proof that originally that loop was mobile" is simply arguing in a circle. His theory cannot, I think, be accepted, for the following reasons:

(*a*) It gives no explanation of the presence of the bladder in an extrasaccular position.

(*b*) In accordance with his views, most cases should occur in the young, while all observers are agreed that the condition is more common over the age of 30, the few cases occurring in children being readily explained by Lockwood's views.

(*c*) If his view were correct, it should be possible to make out the layer of sac behind the adherent cæcum or colon, while all are agreed that no such layer can be discerned.

Symptoms.—These are even less well defined than in the case of a hernia of the bladder; in fact, in nearly all cases the diagnosis is only made at operation. In the case of a simple hernia of the cæcum there will be nothing characteristic unless the appendix can be felt within the sac, as may sometimes happen in children. The presence of acute inflammation in such a displaced appendix has already been noted. In the other two types suspicion should always be aroused if there be a large hernia of long standing which is in part irreducible. It may be possible to distinguish it from a hernia of the bladder, apart from the presence of urinary symptoms in the latter, if the irreducible portion is noticed to lie to the outer side of the reducible part, the reverse being true in the case of the bladder. Owing to the wide neck strangulation is very rare.

At operation the same difficulties in diagnosis will arise as in the case of the bladder, but here the gut will lie posterior and to the outer side. For this reason it is very easy to open into the lumen of the gut instead of into the sac. Great care should, therefore, be exercised in actually opening the sac in all cases. As a general rule, the presence of some abnormality is made clear by the presence of a mass of fatty muscular tissue within the inguinal canal, which differs considerably from the peritoneum of the ordinary hernial sac. When once the sac is opened the condition is made clear either by the presence of a portion of large gut which is seen to be firmly adherent to the posterior wall of the sac and thus to be irreducible, or by the fact that a thick mass can be felt forming the posterior and outer wall of the upper part of the sac.

Treatment.—If there be a simple hernia, the gut can be reduced in a manner identical with that of the small gut and the sac closed in the usual way. If the gut be fixed to the sac by its mesentery or be in part extrasaccular, the operation already described will be found to answer admirably. In such cases care must be taken to separate the vas and spermatic vessels so that the testicle be not injured. In all cases sufficiently wide flaps of sac should be taken so that when folded back the gut is not constricted. When a U-shaped loop of gut is present these flaps should be specially large, so that when brought together there is no resulting angulation of the loop; and both in turning the gut forward and in suturing the flaps together, special care should be taken that the vessels supplying the gut are not injured.

The operation of re-forming a mesentery from the posterior wall of the sac was, as far as I can discover, first devised by Van Heuverswyn[38] in 1893, the sac being then dealt with in the usual way. A similar method has at different times been subsequently advocated by Berger,[2] Morris,[25] Tuffier,[37] Hotchkiss,[13] Wier,[39] and Singley.[32] In the method which I advocate, however, not only are the cæcum and ascending colon freed so that they can be easily reduced within the abdomen, but, the sac being firmly drawn up by the method devised by

Kocher,[16] the opening is entirely obliterated and the ascending colon tends to be drawn up away from the abdominal ring.

In all cases the abdominal wall must be firmly repaired. In most cases it is sufficient to suture the conjoint tendon over the cord to the deep surface of Poupart's ligament. If, however, the wall be weak, the method of implanting two filigrees of silver wire devised by McGavin [22] for this region may be made use of, or, if the hernia be direct, the method of transplanting the rectus, put forward by Bloodgood,[4] may be tried.

Hernia of the Iliac or Pelvic Colon.—This condition may occur on either side of the body, but, as is to be expected, is more common on the left side. As in the case of the cæcum, it may be simple in nature or the gut may show close relationships to the sac wall. The former will alone be found on the right side of the body, a loop of the pelvic colon being readily able to escape into the sac of a right inguinal or femoral hernia, provided it has a sufficiently long mesentery. The true sliding hernia will be limited to the left side of the body.

Anderson [1] was the first to show that the iliac colon may have its length and bend so increased that it passes down to Poupart's ligament, along the whole length of which it may run. In this position the peritoneum, which normally only covers the iliac colon in front, may be directly reflected off the bowel onto the anterior abdominal wall so as to leave a portion of the gut uncovered by peritoneum and in direct relationship with the posterior wall of the inguinal canal. In connection with this anatomical fact, Stoney [34] showed that in cases of sliding hernia the gut present was more commonly the iliac colon. The presence of the pelvic colon is common in such cases, but since this portion of the gut is usually provided with a long mesentery the loop is generally unattached to the sac wall, although, as will be shown, the mesentery itself may at times be so attached.

As in the case of a hernia of the cæcum, the causes of a true sliding hernia may be congenital or acquired. The congenital, as Lockwood [17] points out, will arise in one of the two ways which lead to the formation of the cæcal variety, the

attachment of the gubernaculum or testis in this case being to the iliac colon instead of to the cæcum.

In the acquired type, also, the factors at work are similar to those of the cæcum but owing to the more constant relationships of the peritoneum the methods of production are less variable. Thus there may be a preliminary prolapse of the attachments of the pelvic or iliac colon on the wall of the false pelvis, this being usually part of a general enteroptosis, or the sac may be formed in the first place and by its increase drag down the attachment of the pelvic or iliac colons until they come to lie within and arise from the wall of the sac.

The same three degrees will be recognized as in the last variety, but these degrees will be dependent not upon variations in the attachment of the peritoneum, for in this part of the gut these are much more constant, but upon the portion of the gut which happens to be in the sac. They may be considered as follows:

(*a*) With a definite mesentery—in this case the portion of gut lying within the sac is the pelvic colon. Thus there is a definite mesentery to the gut, but the attachment of this mesentery to the pelvic wall is displaced so that it comes to form part of the sac wall. The mesenteric attachment of the colon must, of necessity, be more or less U-shaped, for the prolapsed gut must form a loop, there being no free projection corresponding to the cæcum (Fig. 14). Such a case was reported by Lockwood[17] where the loop of gut measured two feet and was formed of pelvic colon.

(*b*) In the second variety there is a single piece of large gut which is extrasaccular, this, of necessity, being formed by the iliac colon, the method of attaining this position being identical with that of the cæcum. It will be seen, however, that there must in this case also be a returning portion of gut. This will be formed of pelvic colon and will have a definite mesentery, which is attached to the

sac wall. It therefore occurs when the displacement takes place at the junction of the iliac and pelvic colons. It corresponds with the second degree of that of the cæcum, but differs from it in that it shows the returning portion attached by a mesentery (Fig. 15). Such a case has been recorded by Robinson.[30]

(*c*) In this variety there will be a loop of gut which will be extrasaccular in its whole length. It will occur, therefore, when that portion which is displaced is wholly formed of iliac colon. This was the type of case described by Stoney,[34] and further examples have been recorded by Robinson.[30] It corresponds with the third degree of that of the cæcum (Fig. 13).

It is possible that a sacless hernia might arise here also from a primary prolapse of the iliac colon, so that the posterior surface uncovered by peritoneum comes to lie over the internal inguinal ring and thus is alone prolapsed. It will be seen, however, that as the condition increased the peritoneum covering the anterior surface of the gut would also pass outward, and thus a sac would come to be formed. A true sacless hernia, therefore, could only exist in the early stages when symptoms would be slight or absent. It is probably owing to this that there appears to be no such case reported in the literature.

Symptoms.—These will be as indefinite as those of the cæcum, but, as in that case, the presence of a large hernia in part irreducible should give rise to the suspicion that such a condition is present. The presence of a large ring is also suggestive. Usually the condition is only diagnosed at operation.

Treatment.—The simple types can be easily reduced in the ordinary way. In the other types treatment will be more difficult, and Rankin [28] even goes so far as to state that the condition is inoperable. This, however, is far from being the case, and the method of re-forming the mesentery and sac with invagination of the latter will be found to be simple and to answer

admirably. In all cases care must be taken to thoroughly strengthen the abdominal wall by one of the methods mentioned in the case of the cæcum.

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AN INSTRUMENT FOR ESTABLISHING FECAL DRAINAGE, WITH A REPORT OF ITS USE ON A CASE, AND A CONSIDERATION OF THE SITE FOR MAKING A FECAL FISTULA IN LOW-SEATED INTESTINAL OBSTRUCTION.*

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THE parts of the instrument are shown in Fig. 1. A scale drawing of a vertical mesial section, the natural size, is given in Fig. 2.

The particular use for which the instrument was designed is for the establishment of a fecal fistula, but it can also be used to allow the escape of wind from a clamped-off colon in the establishment of an artificial anus. In the latter instance it would probably be best not to make the joint connection with the bowel quite so tight as for fecal fistula, with a view of retarding the separation of the slough.

The principle employed in the construction of the instrument consists in the mechanical compression of the whole thickness of the bowel wall in a circle around a perforation in the bowel, between a ring introduced within the bowel and a cap closing over the ring from without, which maintains a water-tight joint around the perforation a sufficient length of time for protecting adhesions to take place between the bowel outside the area grasped by the instrument and the abdominal wall, before the instrument cuts through the tissues it compresses. This mechanical device does away with suture of the intestine to the abdominal wall, the bowel being held in position instead by tying the instrument grasping it, into the wound.

The instrument has been tested in five normal dogs and in

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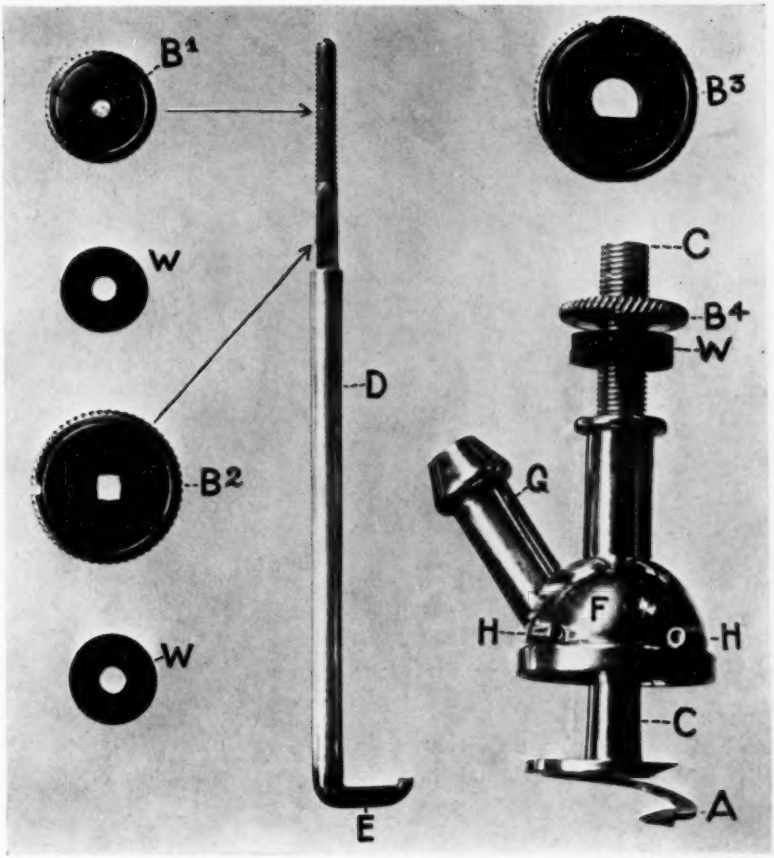
FIG. 1.



Shows the several parts of the fistula instrument. *A*, as here seen, is a corkscrew spiral, connected by a binding post (*P*, Fig. 3 *b*) with a central stem *C*, which is hollow for the passage of the shaft *D*. The spiral can be transformed into a complete ring or wheel by elevating its downward-dipping extremity, which is a spring of tempered steel. The opening and shutting of this spring is regulated by the right-angled arm *E* of the shaft *D*, the revolving of which latter is effected by button 2 (*B* 2), which fits over a square cut portion of the shaft, and the elevation and descent of which is regulated by button (*B* 1), which turns on a thread. With the spring open, the arm *E* being set opposite the binding post (Fig. 3 *a*), the then spiral is passed, with a rotatory turn, within the lumen of the bowel through a small perforation, as far as to the corner where the spiral and the binding post join together, after which the perforation is made to round the corner and is then slid along the binding post onto the central stem (see legend of Fig. 5). Finally, with the manipulating apparatus outside, the spring is closed, converting the spiral into a complete ring (Fig. 3 *b*), against which, within the bowel, the cap *F* outside can then be made to evenly compress the intervening tissues, thereby forming a temporarily water-tight joint around the perforation. The cap *F* is screwed tightly in place by button 4 (*B* 4). Button 3 (*B* 3) is fixed to the central stem *C* and serves as a holder. The rubber washers *W* stopper the joints of the instrument and a rubber tube interrupted with a glass connection, connecting with the pipe (*G*) projecting from the cap, provides the outlet for the drainage from the bowel. *H*, *H*, loop-holes, of which there are four, for anchoring the instrument to the abdominal wall after it has been made to grasp the bowel.

Uofl

one case of intestinal obstruction in man. The operations were all performed under general anæsthesia. In every instance adhesions formed between the bowel outside the area grasped by the instrument and the wound in the abdominal wall, with-

FIG. 2.

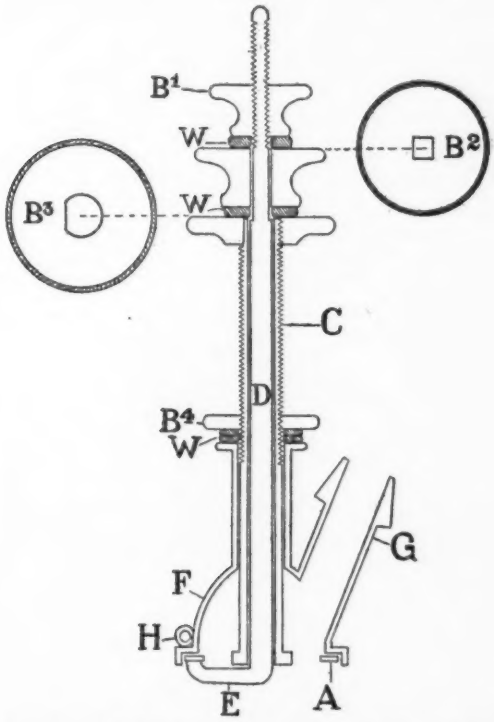


Fig. 2 (*cf.* Fig. 1) is a scale drawing, the natural size, of a vertical mesial section of the instrument. The base of the cap is 43/48 inch in diameter. The bowel is compressed between the ring and the cap in two planes, one circular and one cylindrical, which meet at a right angle over the edge of the ring. The circular plane of compression lies between the upper surface of the ring and the under surface of the rim of the cap, and the cylindrical plane lies between the outer margin of the ring and the flange of the cap. Between the latter surfaces the space is 1/64 inch in width, caught within which the bowel must receive an equal pressure at every point, which area of constriction, together with the right-angular bend in the bowel where the two planes of compression meet over the edge of the ring, affords the main security against leakage. While in principle the fit between the upper surface of the ring and the under surface of the rim of the cap should be an accurate one so as to evenly compress the included tissues, which adjustment is carefully tried for in the construction of the instrument, yet it would not be safe to absolutely rely upon this one plane of compression alone to effect the water-tight joint, since, owing to the flexibility of the spring, it is a little difficult, with the shutting of the latter, to get every point on the upper surface of the resulting ring to lie in one and the same plane. The lettering corresponds to that of Fig. 1.

out any infection of the peritoneal cavity. In the first animal experimented upon no drainage material was introduced into the wound, and, as a result, a severe phlegmon of the abdominal wall developed, from which apparently the animal died. After

this, the placing of a gauze collar around the base of the instrument (Figs. 6 and 7) was introduced into the technic of the operation, and then no sepsis occurred.

In the first three dogs and in the patient the abdominal incision was a transrectus one, and the loop-holes of the cap were tied to the margins of the cut in the anterior layer of the rectus sheath. In the last two dogs the incision was transverse, dividing the linea semilunaris and the abdominal wall external thereto, the loop-holes of the cap were tied to the outer surface of the external oblique muscle at points about 1 cm. from its

FIG. 3*a*.

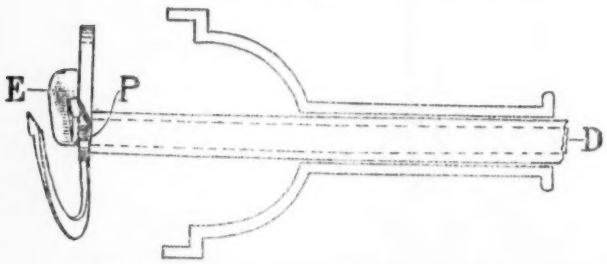


FIG. 3*b*.

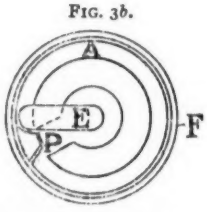


Fig. 3 *a* shows the adjustment of the instrument preparatory to use. The cap is slid up on the stem. The spring is open and the right-angled arm *E* of the shaft *D* is set opposite the binding post *P*, where it is secured firmly in position by turning up tight button 1 (Figs. 1 and 2). Buttons 2 and 3 are properly notched, so that when the two notches lie opposite each other the arm *E* underlies the binding post. The instrument, during the introduction of the spiral, should be held with its long axis approaching the horizontal position (*cf.* Fig. 5).

Fig. 3 *b*, drawn to a scale the natural size, shows the base of the instrument with the spring closed, the spiral thus having been converted into the ring, which closure should be made after the complete passage of the spiral through the perforation to within the lumen of the bowel. To effect closure of the open spring, the right-angled arm *E* of the central shaft, after having been loosened from its position of fixation described under Fig. 3 *a*, is rotated by turning button 2 (Figs. 1 and 2) from left to right, until it encounters the notch near the tip of the spring, and then, by screwing button 1 up tightly, the spring is raised into the position of completing the circle. If the rubber washer beneath button 1 is dry it will oppose great friction to turning this button as the grip of the latter tightens. The friction can be overcome by a drop of oil.

cut edges, and the deep portion of the muscular opening was narrowed around the extruded bowel, as recommended herewith. In the fourth dog, while under ether just before being killed two days after the operation, it was found that the muscle-fibres of the abdominal wall maintained a loose closure of the fistulous opening. The finger inserted through the fistula was felt to dilate slightly the opening in the abdominal wall, and, as it was withdrawn, a lot of fluid escaped from the intestine, which before had apparently been retained by a sphincter-like action of the encircling muscle fibres. The specimen pictured in Fig. 7 was from the fifth dog.

THE CASE.—The patient, a male, weighing about 225 pounds, was admitted to St. Vincent's Hospital on September 20, 1911, to the service of Dr. Edward L. Keyes, Jr., having fallen 30 feet and sustained an injury to the pelvis. On the fourth day a fecal fistula for the relief of intestinal obstruction was established as follows: Chloroform and oxygen anæsthesia was administered by Dr. Gwathmey. The incision was made through the outer fibres of the right rectus muscle, the skin cut beginning at the level of the umbilicus and extending downward about 3½ inches, while the opening through the abdominal wall, placed centrally within the skin cut, was about 1 inch in length. The presenting piece of bowel could not be displaced and an adjoining loop substituted for it, so fixed in their positions were the distended coils. It had been planned at this juncture to include a sufficient area of a distended piece of bowel within the grasp of two curved intestinal clamps having thin spring blades protected with rubber, and draw it outside the abdominal wall while the fistula connecting-joint was being adjusted in position, but this was found impossible to carry out owing to the shortness of the mesenteric tether, which barely allowed the gut to be drawn sufficiently far into the abdominal wound to work on. The two intestinal clamps were at the start applied to the presenting piece of bowel, but the included area was so small that one clamp had to be removed. There was some little escape of gas during the introduction of the spiral, but there was a much greater escape of gas through the tube attached to the fistula connecting-joint after the latter was in place. There was not sufficient room in this wound to introduce gauze for the protection of the peritoneal cavity, but there was essentially no escape of intestinal contents. The cap was screwed down as firmly as possible against the ring, thus compressing the bowel around the perforation. Silkworm-gut sutures were inserted to attach the four loop-holes of the cap to the edges of the cut in the anterior portion of the rectus sheath, before tying which a narrow collar of iodoform gauze was placed beneath them around the line of juncture of the instrument with the bowel, for drainage. After tying the silkworm-gut sutures the ends were left long, protruding through the wound, so that they could easily be found for subsequent removal, and the wound was then filled with iodoform gauze.

Subsequent Course.—There was immediate and complete re-

lief to the distention. The patient lived 22 hours following the operation. About 15 hours after the operation about 1 pint of intestinal contents dropped freely from the tube, at which time it was noted that the abdomen had become considerably distended again. Eighteen hours after the operation the patient was fully distended again and vomiting. The instrument was then evidently obstructed, as fluid could not be forced back through the rubber tube into the intestine. The rubber tube was cut off 2 or 3 inches from the instrument and then, by the injection of olive oil and probing with a paracentesis tympani knife, the obstruction at the site of the fistula was apparently overcome. The pieces of the tube were joined together again by a glass connection. Small quantities of fluid injected through the tube would return, yet practically no gas escaped any longer, to test which latter the free end of the drainage tube was put under water.

Post Mortem.—Within the circle of compression there was a slough which had not cut through, so that no intestinal leakage had occurred into the abdominal wound. There was a firm adhesion of the bowel around the fistulous opening to the abdominal wall. There was no peritonitis. The iodoform gauze collar was firmly adherent. On one side the collar had gotten pushed well down alongside the bowel, so that it prevented so extensive an adhesion to the abdominal wall on this side as was present on the other. A little more than half the lumen of the bowel was taken up by the fistula and its peripheral adhesions. The instrument used, however, was an early model, having a cap the base of which measured one inch in diameter. The site in the bowel where the fistula was made was found to be about 12 feet from the ileocæcal valve. The lower ileum was found to occupy the region in front of the ascending colon. The sigmoid flexure dipped horseshoe-shaped from two sites of fixation at the brim down into the pelvic cavity, which it filled so snugly that it was pulled out with the overcoming of considerable suction. An angulation here seemed to have been the cause of the obstruction. The pelvic cavity was very much narrowed with fat, and the sigmoid loop was fatty. There was a diastasis of the pubic bones of about 2½ inches, and the soft parts were stripped from these bones both in front and behind. In the cavity that had formed at this situation there was collected about 6 to 8 ounces of bloody fluid. There was no infiltration around either kidney.

Other Notes from History.—A catheter tied in the patient's bladder on admission had, at the beginning, drained a few ounces of bloody urine, and then anuria supervened. Later a small quantity of urine could be withdrawn. On the fourth day a perineal and scrotal extravasation of urine developed, which subsided with incision. During the third and fourth days the temperature had been around 98½° most of the time.

Observations.—It is of interest that an apparently correctly made fecal fistula which had been patulous for at least 15 hours, had not, after the primary relief, been affording adequate drainage of the bowel, since at the expiration of this time distention had begun to recur; and also that after another three hours, when an obstruction which had in the meantime occurred at the site of the fistula was relieved, no further escape of gas took place. In trying to account for this result it has seemed possible that an angulation of the bowel might have occurred at the site of fistula formation, or, in view of the fact that the fistulous opening was situated about 12 feet along the gut above the ileocæcal valve, it might be explained on physiological grounds, that, in order to get effectual drainage of a distended small intestine, it may be necessary to tap the latter near the ileocæcal valve. Moynihan [1] calls attention to the fact that "fluid taken by the mouth speedily excites a wave of peristaltic activity in the lowest ileum." He continues, "In cases of typhlotomy or of enterostomy, in which the cæcum or lowest ileum is opened, it can constantly be observed that the drinking of a little fluid excites a considerable disturbance in this region." For the latter reason, as well as in the interest of establishing the fistula at a situation which would allow the best nourishment of the patient, a study was made on the cadaver to determine an incision through the abdominal wall which would with greatest invariability expose a piece of gut in the ileocæcal region in the presence of low-seated intestinal obstruction.

The physical conditions attendant upon intestinal obstruction are so vastly different from the normal that a proper technic of joining the fistula instrument with the intestine in

[1] Moynihan: Acute Emergencies of Abdominal Disease, Brit. Med. Journ., April 1, 1911.

the obstructed condition had also to be made the subject of special study. The complicating circumstance in connecting the fistula instrument with the bowel in a case of intestinal obstruction is, that in great abdominal distention the intestines next the abdominal wall in the lower right quadrant of the peritoneal cavity generally lie at the limit of their mesenteric tether, so that the piece of bowel presenting at a wound in the abdominal wall within this area cannot be drawn outside of the peritoneal cavity for manipulation. Slack in the bowel can be gained only by getting the abdominal wall to retract, and this, in turn, can be attained only by the elimination of gas from the distended intestines; so that the primary problem resolves itself into how to allow the escape of gas from a piece of distended intestine presenting in a small abdominal incision, which is immobilized flush with the parietal peritoneum both by a general intestinal distention and a limiting mesenteric attachment, without soiling the peritoneal cavity with intestinal contents.

These problems, as well as a proper technic of fixing the fistula instrument in the wound in the abdominal wall, were studied on cadavers.

CADAVER STUDIES FOR THE DETERMINATION OF AN ABDOMINAL INCISION WHICH WOULD WITH GREATEST INVARIABILITY EXPOSE A PIECE OF DISTENDED GUT IN NEAR CONTINUITY WITH THE ILEOCÆCAL VALVE, IN THE PRESENCE OF LOW-SEATED INTESTINAL OBSTRUCTION.

Observations were made on 19 bodies. *Since in the patient the lower ileum had occupied exclusively the right flank,* lying in front of the ascending colon, the course taken by the ileum from the ileocæcal valve was made a record of in each body. For the determining of the abdominal incision it was necessary to inflate the intestines. Two conditions of distention were studied: one, that in which the cæcum took part in the general distention, and the other, that in which the cæcum was collapsed and small intestine only was distended. To study the former condition, the inflation was generally made through the transverse colon, while to study the latter the lower ileum was tied off and the inflation made through a piece of small intestine picked up from the left side of the pelvis.

Two right-sided incisions in particular were made the object of study. Both were transverse, one opposite the junction of the outer with the middle thirds of Poupart's ligament, and the other opposite the most

prominent portion of the anterior superior spine of the ilium. Both cut through the internal oblique and transversalis muscles in the course of their fibres. The midpoint of the former was about 1½ inches internal to Poupart's ligament, making an opening through which the most direct access to the lateral portion of the pelvic brim can be had. This incision generally lies below the level of a distended cæcum.

The higher incision first cuts the abdominal wall just external to the linea semilunaris and then cuts through the linea semilunaris, making an opening about 1½ inches in length (Fig. 4). The linea semilunaris in the course of this incision generally corresponds to a point midway between the anterior superior spine of the ilium and the middle line of the abdomen. Its division allows the wound to gape to a considerably additional extent, and affords as well, to the exploring finger, an added reach in the direction of the brim and promontory. The inner extremity of this incision, in both distention and collapse of the abdomen, lies directly over the bony angle at the right side of the promontory, thus indicating a very direct route to the region of the ileocæcal valve and to the site of lowest attachment of the mesenteric root. This incision exposes a distended cæcum, unless the latter be situated abnormally high.

In the series of observations on the 19 cadavers, only those records of individual cases which it was thought might contribute information of interest to the subject are here given. In 13 of the cadavers the intestines were inflated. The first three of these inflation tests were made on opened bellies to seek for variability in the position of the lower ileum in the presence of general intestinal distention. Ten inflation tests were made on closed bellies for the study of abdominal incisions in relation to the presenting pieces of distended intestine. From the latter studies it was determined that a distended cæcum would generally present in the higher of the two transverse incisions, but not in the lower. Of particular practical interest in this series were the observations made in the presence of inflated small intestines alone, the colon being collapsed (subjects *d*, *e*, *f*, *g*, and *h*). In six of the cadavers, simply the location of the lower ileum within the peritoneal cavity was noted, without inflation.

The following three cases are those on which the inflation tests were made on opened bellies the intestines of which had undergone previous manipulation:

(*a*). Thin male. Pelvis roomy. The lower ileum was first deposited in the pelvic cavity, and then the intestines were inflated through the sigmoid flexure. With the inflation, the lower ileum rose out of the pelvis and took a position in the right flank to the inner side of the cæcum and in front of the ascending colon, while some of the mid-loops of small intestine slid down into the pelvic cavity to take its place. The lowest loop of ileum that lay in the pelvic cavity was about 8 feet above the ileocæcal valve. It was estimated that a loop of ileum about 2½ feet above the ileocæcal valve about corresponded to a mid-point between the 10th costal cartilage and the anterior superior spine of the ilium.

(*b*). Fat male. Pelvis roomy. From the ileocæcal valve the ileum passed directly into the pelvic cavity. The 4 inches of ileum adjoining the ileocæcal valve were bound firmly down across the psoas muscle.

Intestines distended through transverse colon. A loop of small intestine lying in front of the distended cæcum, about corresponding to the site of the incision in the patient, was about 7 feet above the ileocæcal valve. A loop picked up just above the pubis a little to the right of the median line had about 3 feet of intestine intervening between it and the ileocæcal valve.

(*c*). Thin male. Pelvis roomy. The ileum descended from the ileocæcal valve into the pelvic cavity. Its four inches nearest the cæcum were attached by a very short mesentery, which allowed this segment very little mobility. The cæcum was free and distended tremendously. The loop of ileum lying just internal to the distended cæcum, opposite the ileocæcal valve, had about 4 feet of intestine intervening between it and the latter.

The following observations on the relations of the two transverse abdominal incisions to the distended small intestines were made. In cadavers *g* and *h* the relations of the distended bowel to the lower transverse incision were not recorded. It is distinctly remembered, however, that in these bodies the lower incision offered no advantage over the upper, and all the preference was in favor of the latter. In cadaver *i* both large and small gut were inflated.

(*d*). With the lowest ileum, which here passed from the ileocæcal valve directly down into the pelvic cavity, tied in its terminal portion, and the small intestine inflated, the loop that presented in the transverse incision opposite the anterior superior iliac spine was about 2 feet from the ileocæcal valve.

(*e*). The lowest 1½ feet of ileum had a short mesentery and lay in the right iliac fossa below a high-seated cæcum. The next higher piece of ileum formed a loop dipping into the pelvic cavity and then ascended into the right flank. The ileum was tied about 1½ feet from the ileocæcal valve, and, after inflation, the piece of small intestine that presented in the transverse incision opposite the anterior superior iliac spine was about 1 foot above the site of ligature. In the transverse incision opposite the junction of the outer with the middle thirds of Poupart's ligament, the loop that presented was continuous with that found in the upper incision.

(*f*). The ileum was tied very near the ileocæcal valve. With inflation of the small intestines, two pieces of distended gut presented in the transverse wound opposite the anterior superior iliac spine, the internal of which was about 5 inches and the external of which was about 15 inches from the seat of ligature of the ileum. The external of these pieces was directly continuous with the piece of bowel that presented in the transverse wound opposite the junction of the outer with the middle thirds of Poupart's ligament. A third piece of distended gut lying in the iliac fossa external to the abdominal incisions was about 4½ feet above the seat of ligature, showing that the piece of intestine farthest to the right in the pelvis is not necessarily the piece in closest continuity with the ileocæcal valve. In distention the lowest ileum passed over the brim to the right of the promontory, and then went diagonally across the pelvis to the left, lying superficial to the mesenteric root descending from above the promontory into the pelvic cavity. In this cadaver the distention held very tight and afforded an excellent opportunity to palpate the mesentery. The finger

took a direct route between the two presenting coils down to the brim, and, following the latter inward, could palpate a transverse mesentery, here tense, attached between the spinal column and the ileocæcal valve, which was associated with the piece of gut presenting at the inner part of the wound, distinguishing the same as being near the ileocæcal valve.

(*g*). Before inflation the lower ileum was situated entirely above the brim. The ileum was tied about 6 inches above the ileocæcal valve. With inflation the lowest ileum descended into the pelvic cavity, forming a short loop over the brim. Two distended pieces of bowel presented about equally in the upper and lower halves of the transverse incision opposite the anterior superior iliac spine. The finger could be insinuated between these two coils directly to the brim, palpation along which toward the promontory distinguished a transverse mesenteric attachment between the spinal column and the ileocæcal valve in near association with the lower presenting piece of bowel, which would seem to indicate nearness of such piece of bowel to the ileocæcal valve, as was here found to be the case. The lower piece of presenting bowel was found to be about 10 inches and the upper piece about 3 feet from the ileocæcal valve.

(*h*). The lowest ileum passed into the pelvic cavity. It was tied about 4 inches from the ileocæcal valve and the small intestines were inflated. The lower 4½ feet of the ileum were found collapsed in the right side of the pelvic cavity and the first inflated loop adjoining the collapsed portion rose directly out of the pelvic cavity and presented in the transverse wound opposite the anterior superior iliac spine. The presenting piece of intestine was about 1 foot above the collapsed portion.

(*i*). Very fat female. Before inflating the intestine it was observed that the lowest 3 feet of ileum formed a loop upward into the region of the cæcum and ascending colon. The next higher portion of the ileum occupied the lower right iliac region and pelvic cavity. Distention effected through colon. At the inner angle of the transverse wound opposite the anterior superior iliac spine, there presented alongside the distended cæcum a piece of small intestine which was about 5 feet above the ileocæcal valve.

Variations in the Anatomic Arrangement of the Lower Ileum.—Out of the 19 cadavers studied, the distended lower ileum occupied exclusively the right flank in one instance (subject *a*). The conditions in this cadaver, however, were not exactly similar to those existing in the patient, since in the former the belly had been widely opened before inflation, yet, since the arrangement of the coils in distention is probably influenced chiefly by the conformation of the mesentery, it would seem fair to include both these subjects in the same class. Once (subject *i*) the lowest 3 feet of ileum formed a loop, ascending into the region of the cæcum and ascending colon before the bowel descended into the pelvic cavity, and again the lowest 1 foot of ileum did the same. In three instances

(including subject *e*) the ileum passing from the ileocæcal valve formed a loop in the right iliac fossa before descending into the pelvic cavity. In two instances (including subject *f*) the lowest ileum passed from the ileocæcal valve diagonally across the pelvis downward and to the left above the brim, while the loops farthest to the right in the iliac fossæ were respectively about 4½ and (probably) about 7 feet above their ileocæcal valves. In eleven instances the lowest ileum passed over the brim directly into the pelvic cavity.

The Immobility of Distended Intestines.—In the intestinal distention produced on the cadavers, the loops of small intestine in the right iliac region were generally found in contact with the parietal peritoneum at the limit of their mesenteric tether, so that the presenting piece of gut could not be drawn outside of the peritoneal cavity, and were so tightly wedged together that the loop presenting in the wound could not be displaced and an adjoining one substituted for it. With the finger the mesentery could be felt to be taut, and it seemed as though a considerable traction on the same must be an accompaniment of great abdominal distention.

Palpation of the Mesenteric Attachments through the Incision Opposite the Anterior Superior Iliac Spine.—In the case of a distended cæcum, palpation within the peritoneal cavity is of use only in determining whether this piece of bowel be free or attached. With, however, the colon collapsed and small intestine presenting in the wound, it would be helpful if by palpation an estimate of the probable length of bowel intervening between the presenting piece of intestine and the ileocæcal valve could be formed. The writer would propose the *pelvic brim* as the location first to be sought for by the exploring finger. Here a piece of lower ileum passing from the neighborhood of the ileocæcal valve into the pelvic cavity, usually at a site just to the right of the promontory, can be detected, or, when this piece of bowel rather lies forward in the pelvic cavity, it may be identified by pushing the finger upward from the brim and feeling its mesentery attached transversely between the spinal column and the ileocæcal valve. In order to reach the brim the finger must pass beneath, or

external to, any intervening mesentery. In cases where the lowest ileum descends into the pelvic cavity, when the finger can be passed external to the presenting piece of bowel in a very direct line to the brim, that piece of bowel is likely in near continuity with the ileocæcal valve (*cf.* subject *f*). In palpating, the greatest reach in an inward direction can be gotten by the middle finger with hand supine.

The advantages of the transverse incision opposite the anterior superior iliac spine, as a primary choice, over that opposite the junction of the outer and middle thirds of Poupart's ligament.

1. If the obstruction is in the large intestine, the former incision will expose the distended cæcum, unless the latter be situated abnormally high.

2. With small intestines alone distended after tying the terminal portion of the ileum in 4 cadavers, the pieces of bowel nearest the ileocæcal valve which presented in the higher incision were, respectively, 2 feet, 1 foot, 5 inches, and 4 inches (subjects *d*, *e*, *f*, and *g*) above the seat of ligature. These observations indicate but a general tendency for a very low piece of distended ileum to be in relation with the higher incision (*cf.* subjects *a*, *b*, *h*, and *i*).

3. The higher incision is nearer the lowest site of attachment of the mesenteric root to the posterior parietes, so that the mesenteric tether of a piece of ileum presenting in this wound would be much more liable to allow a greater amount of extrusion of its attached bowel upon relief of the distention than would the mesentery of a piece of bowel presenting in the lower incision.

4. Palpation of the mesenteric attachments is more direct through the higher incision.

PROPOSED TECHNIC OF ESTABLISHING A FECAL FISTULA FOR THE RELIEF OF A LOW-SEATED INTESTINAL OBSTRUCTION WITH THE USE OF THE FISTULA CONNECTING-JOINT.

Since the technic of establishing a fecal fistula for the relief of intestinal obstruction as here proposed has had to

be based largely upon cadaver study, though carefully planned in accordance with surgical principles, it must yet receive the test of experience before it can be thoroughly approved. It can, however, be said in its favor that, with the use of this mechanical device which makes in a few minutes a water-tight drainage connection with the bowel around a small puncture, with no intestinal suturing, the operation would surely seem to be attended with much less danger of infecting the peritoneal cavity than has attended previous methods, that the operation can be more easily and rapidly performed than with any other technic, and that, with no added danger, relief from the intra-abdominal tension is gained at once.

The general technic of the operation as here proposed is indicated in the legends of Figs. 3, 4, 5, and 6, while Fig. 7 pictures the result attained by the operation performed on a normal dog. The following discussion of the technic of the operation amplifies the legends.

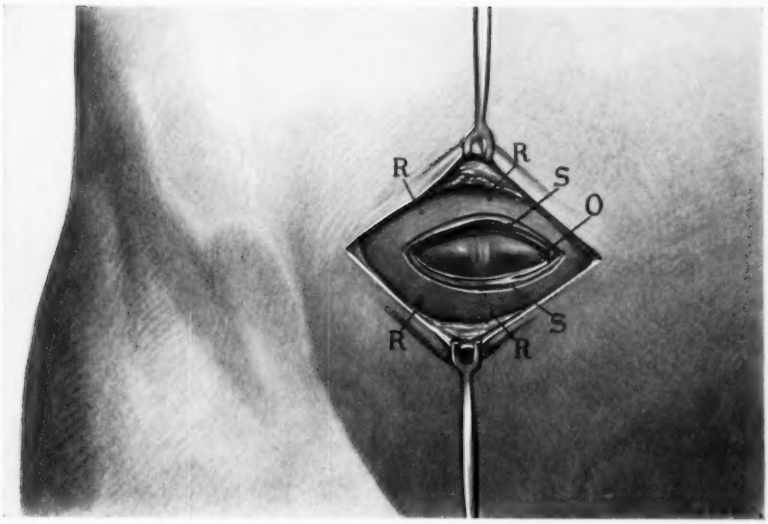
The Holding-thread.—The principle of the holding-thread placed close to the site of puncture of the bowel, as a means of preventing soiling from intestinal contents, has been utilized by Coffey[2] in connection with opening the stomach. Coffey raises forward by holding-threads an anterior area of stomach wall for incision, thus causing the opposite portion to pouch dependently for the collection of the stomach contents, which are removed by means of a ladle and gauze wiping. In like manner here, the raising forward of the site of puncture should distance it from the level of the gravitated intestinal contents, thus allowing the escape of gas with a minimum of ooze.

The holding-thread must be securely placed beyond any possibility of its tearing out, and therefore it would seem best that the needle placing it should pass through the interior of the bowel, making, of course, sure that this site of puncture be later included within the area encompassed by the compressing circle of the instrument.

The holding-thread should likewise catch the presenting

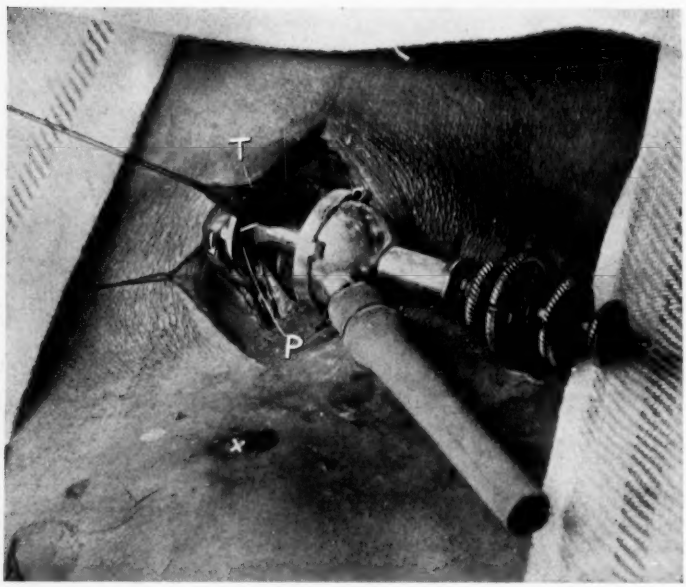
[2] Coffey: Jour. Amer. Med. Assn., lvii, 1911, p. 1034.

FIG. 4.



Proposed incision of primary choice for the establishment of a fecal fistula in low-seated intestinal obstruction (see pp. 113 and 119). The incision is one across the right iliac fossa at a situation which will generally uncover a distended cæcum, or, if the obstruction is at or near the ileocæcal valve, most probably a low loop of distended ileum. It is made in the transverse line between the anterior superior spines of the ilia and cuts through the abdominal wall on the right side, first just external to the linea semilunaris and then through the linea semilunaris, making an opening in the abdominal wall about 1½ inches in length. The division of the linea semilunaris allows the wound to gape, thus making as broad as possible an exposure of the bowel. The inner portion of this incision is situated directly over the bony angle of the brim at the right of the promontory, lies in front of the normally situated ileocæcal valve, and is in near relation with the site of lowest attachment of the mesenteric root. The dots indicate the sites for the sutures seen *in situ* in Fig. 6. *O*, site, at the inner angle of the wound, of introducing the holding suture in a presenting distended cæcum bound down in the external portion of the iliac fossa, which admits of the greatest amount of slack being drawn out of the peritoneal cavity centrally into the wound (see p. 119). With the cæcum bound down in the iliac fossa no slack bowel can be drawn inward from the outer angle of the wound, so that the holding stitch should then not catch the bowel at the latter situation. *R, R, R, R*, sites for the four silkworm-gut sutures anchoring the fistula instrument to the aponeurosis of the external oblique muscle, about 1 cm. from the edges of the cut. *S, S*, site of passing a catgut suture through the internal oblique and transversalis muscles and the parietal peritoneum, to narrow this deep portion of the abdominal wound around the extruded bowel beneath the portion grasped by the instrument.

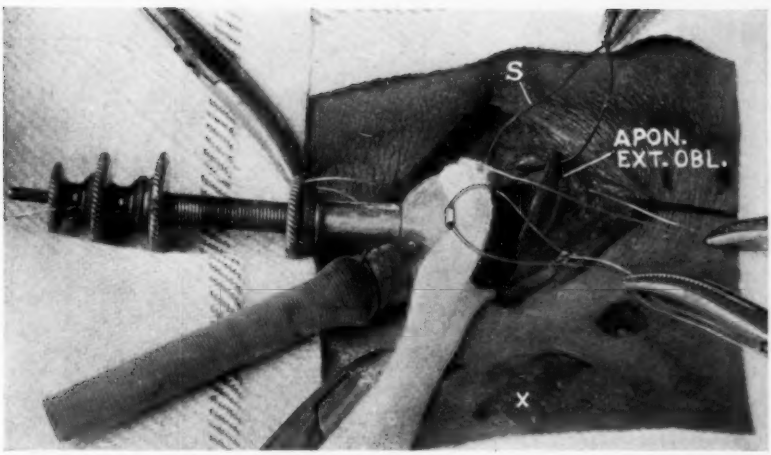
FIG. 5.



Fixation of the instrument in the bowel (planned from cadaver study) (see p. 119). A gauze strip should, if possible, be placed so as to protect the peritoneal cavity from infection. A holding-thread is first made to catch deeply the presenting piece of bowel at a site which permits of slack being drawn into the wound (see p. 118), and thereafter is held taut. A small opening about ¼ inch in diameter is cut in the bowel near the thread. On the cadaver, with puncture of the bowel gas is eliminated sufficiently to cause enough retraction of the abdominal wall so that the piece of bowel caught by the holding-thread can be drawn into the wound in a tent-like fold, which is the position of choice for the introduction of the spiral. With the instrument adjusted (Fig. 3 *a*) for introduction of the spiral, the latter is now inserted through the opening by a corkscrew turn in the direction of the cleft between the slopes of the tent-like fold. Thus during this manipulation the shaft of the instrument approaches the horizontal position. In order that the free extremity of the spiral shall not catch on the bowel during its introduction, the rim of the introduced portion should be first pushed into the bowel in a direction away from the operator, following the bowel wall, and then sunk backward within the lumen of the gut. *T*, contour caused by the contact of the rim of the introduced portion with the interior of the bowel.

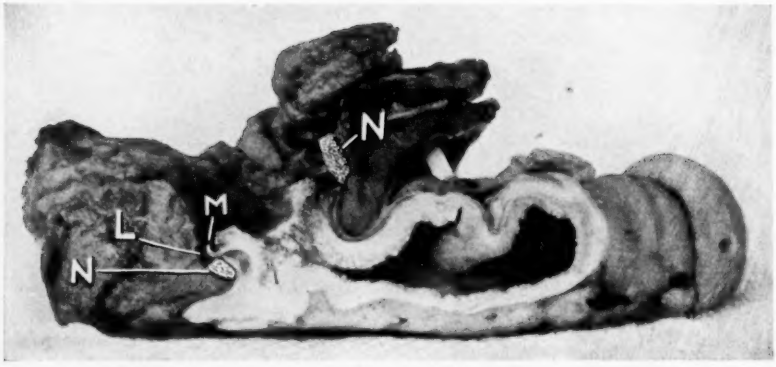
When the spiral has been introduced up to the post (*P*) which binds it to the central stem, then the opening in the bowel is made to turn the corner and pass over the binding post onto the central stem, by pulling on the tissues which tend to gather at this situation into an obstructing fold, in the direction of the *arrow* (see p. 120). As the perforation in the gut rounds the corner the instrument is raised into the vertical position, and, holding the bowel with the thread, the binding post is pushed within its lumen until the perforation encircles the central stem. The spring is now closed (Fig. 3 *b*), the holding-thread is cut away, the instrument now serving as tractor, and the cap is brought down over the ring within the bowel so as to include the punctured areas, and screwed firmly in place. *X* on anterior superior spine of ilium.

FIG. 6.



Plan of fixation of the bowel in the transverse abdominal wound here recommended (*cf.* Fig. 4 and see p. 121). No intestinal sutures are used. Instead, after the instrument has been made to grasp the bowel, the four loop-holes around the margin of the base of the cap are bound by silkworm-gut sutures, two on either side of the wound, to the aponeurosis of the external oblique muscle at points about 1 cm. from its cut edges. Before tying any of these sutures a collar of ¼-inch-wide folded iodoform gauze should be passed beneath them so as to encircle the base of the cap. Without a drain of this sort in the first dog test of the instrument, a severe phlegmon of the abdominal wall resulted. Each two sutures fixing the instrument to the same side of the wound should grasp the aponeurosis at points a sufficient distance apart, so that when they are tied, the intervening aponeurosis will not be drawn snugly against the base of the cap, since, if the latter is done, the gauze drain is then depressed between the bowel and the abdominal wall, thus diminishing the extent of the adhesion in this situation (see Fig. 7). Also before tying these fixation sutures, a catgut stitch *S*, grasping the internal oblique and transversalis muscles and the parietal peritoneum on either side of the wound, narrows the latter around the extruded portion of the gut to a diameter less than that of the base of the cap. A collar of deep tissue of the abdominal wall is thus brought snugly and securely around the gut for adhesion, throwing the area for fistula formation well outside of the peritoneal cavity. A second catgut stitch is inserted if necessary for closure of the peritoneal opening. The ends of the silkworm-gut sutures are left long to facilitate the subsequent removal of the sutures. *X* on anterior superior spine of the ilium.

FIG. 7



Cross section of a dog specimen of a fecal fistula established by the use of the fistula instrument, removed 22 hours after operation, and hardened before the instrument was cut free. The area included within the circle of compression had sloughed out. The notch *L* had received the flange (Fig. 2), turned at a right angle around the margin of the base of the cap. The thin edge of tissue *M* forming the inner boundary of this notch corresponds to the site of separation of the slough at the outer limit of the circle of compression. The incision was a transverse one at the outer border of the right rectus muscle, cutting the linea semilunaris. The four loop-holes around the base of the cap, after the instrument had been made to grasp the bowel, had been anchored to the outer surface of the external oblique muscle on either side of the wound about 1 cm. from its cut edges, so that the bowel was drawn well into the abdominal wound. The wound through the internal oblique and transversalis muscles and the parietal peritoneum was at the same time narrowed rather closely around the protruded bowel, so that this deeper portion of the abdominal wound is seen to have underlapped the base of the instrument, thus causing the bowel to flare a little outside of the level of narrowing. Within the peritoneal cavity the bowel has also flared a little around the opening, so that an adhesion has taken place as well between peritoneal surfaces. The portion of the gauze drain *N* on the left side of the illustration is seen to lie between the bowel and the abdominal wall below the level of the compressing circle of the instrument, thus diminishing the extent of the adhesion in this situation. The deep position of the drain on this side was due to the catching of the external oblique by the two fixation stiches of this side at points situated so closely together that there was no space for the gauze collar to ride up between them alongside of the instrument.

piece of bowel at a situation which will admit of the greatest possible amount of slack being drawn out of the peritoneal cavity centrally into the wound, so that, with the relief of intra-abdominal tension resulting from puncture of the bowel, the holding-stitch can both draw the site of puncture up to as great a height as possible outside of the peritoneal cavity, and at the same time form the tent-like fold (Fig. 5) which accommodates the manipulations of installing the fistula instrument in place. In the case of a distended cæcum fixed to the outer portion of the iliac fossa, the greatest amount of slack can be secured by catching this bowel with the holding-thread at the inner angle of the transverse abdominal wound (Fig. 4, O), since internally a cæcum thus attached is free and such holding-thread can, therefore, be made to pull its site of fixation in the bowel in an outward direction. On the other hand, a holding-thread catching such bowel at the outer angle of the wound would be unable to draw any slack inward, owing to the attachment of the intestine externally in the iliac fossa. In one cadaver, in which the lower extremity of a perfectly free cæcum, in the presence of general intestinal distention, reached no further downward than to protrude into the transverse wound opposite the anterior superior spine of the ilium, then but little slack could be drawn from any one direction, yet a little more could be drawn from above than from either side, and it was found that the greatest amount of slack could be pulled out of the peritoneal cavity by placing the holding-stitch in the presenting cæcum at a site corresponding to the middle of the incision through the abdominal wall, and pulling on it in a downward and forward direction. With this fixation of the bowel the further technic of adjusting the instrument was carried out in accordance with the regular plan.

Fixation of the Instrument in the Bowel (Fig. 5).—The success in introducing the spiral (*A*, Fig. 1) within the bowel depends upon the ability to keep the extremity of the spring free from catching on a fold of bowel. The position of the gut most favorable for the introduction of the spiral through the perforation is the tent-like fold brought into being by

traction on the holding-thread after puncture of the bowel has been made. With the shaft of the instrument held perpendicularly to a plane passing between the two slopes of this tent-like fold of bowel, the extremity of the spiral is made to enter the puncture and to then turn into the lumen of the bowel between the layers of the fold, which latter it can be made to escape until it has nearly made the complete turn and comes up into the top of the tent.

To keep the extremity free during this manipulation, the rim of the introduced portion must first be pushed away from the operator against the bowel surface on the further side of the holding-thread (Fig. 5, *T*), and later, as the introduction progresses, with this site of contact of the rim with the bowel maintained, the extremity is made to sink posteriorly into the bowel cavity. When the extremity reaches the top of the tent-like fold, it catches on the mucous membrane and just afterward the perforation comes up against the binding post (Fig. 5, *P*), thus causing a gathering of the bowel at the opening of the spring. This gathering makes it impossible to draw the perforation in the bowel around the corner where the spiral joins the binding post by further pulling on the holding-thread. The obstructing fold can, however, be liberated by traction on the bowel just proximal to the perforation in a direction toward the operator (Fig. 5, *arrow*), which first pulls the gathering out flat, thus clearing the extremity of the spring, and then, continued in the same direction, readily draws the opening in the gut around the corner of the instrument.

In introducing the point of the spiral through a puncture in a thick piece of gut, as the sigmoid flexure in the making of an artificial anus, it may be necessary to grasp with forceps and evert the aperture in the mucous membrane.

When the cap is screwed down into place, compressing the bowel against the ring, the axis of the metal pipe (Fig. 2, *G*) leading from the cap should be out of the line of the binding post (*P*) and the arm *E* (Fig. 3 *b*), so that if it be found necessary to clear the drainage channel by passing a fine probing instrument through the metal pipe into the bowel, such instrument will not meet with the obstruction of these cross-lying

metal parts. A glass tube connection should be made to interrupt the continuity of the rubber drainage tube near the instrument.

Fixation of the Fistula Instrument to the Abdominal Wall. The technic of fixation of the fistula connecting-joint grasping the bowel, to the abdominal wall, described in the legends of Figs. 4, 6, and 7, seems to be a correct one for the transverse abdominal incision here recommended. At the site of this incision the structure of the abdominal wall is very thin at the linea semilunaris, external to which it gradually increases in thickness, so that the fixing of the cap (diameter of base 43/48 inch) of the instrument in this situation to the front of the aponeurosis of the external oblique 1 cm. from its cut edges, and the drawing of the deeper structures of the abdominal wall in a collar around the intestine beneath the base of the instrument, seemed always capable of accomplishment without compromising too much of the lumen of the bowel. In a thick part of the abdominal wall, however, the instrument should probably rather be anchored to the edges of the superficial portion of the wall structure. In the patient, with the latter technic, and using an instrument having a base one inch in diameter, a little more than half the lumen of the bowel was taken up in a transrectus wound.

The ends of the silkworm-gut stitches anchoring the instrument in the wound should be left long to facilitate removal of the stitches. The gauze collar at the junction of the instrument with the bowel should be drawn well up against the base of the instrument after the fixation stitches have been tied. The superficial wound should be packed loosely with gauze.

The Removal of the Fistula Instrument.—In the fifth dog the instrument had cut through the bowel within 22 hours. The adhesions around the fistula in this animal (Fig. 7) were very strong, as also were those in the patient, who had lived an equal length of time following the operation. Unless the ends of the fixation stitches be left long, it is difficult to find and cut loose these stitches. The gauze collar should be left in the wound, to come away by ulceration, lest, if forcibly removed too early, important adhesions be torn.

RUPTURE OR SPRAIN FRACTURE OF THE LIGAMENTUM PATELLÆ.

BY WILLIAM H. LUCKETT, M.D.,
OF NEW YORK CITY.

RUPTURE of the quadriceps tendon above the patella is fairly frequent. Fracture of the patella is common, but rupture of the tendon below the patella is rare. The case reported below probably belongs to the class first described by Collender. Sir Wm. Bennet has also called attention to this class of injury, and Ross and Stewart have recently carried on some experimental work, the correctness of which this case tends to prove.

R. D., casemaker, fifty-one years old; admitted to my service at Bellevue and Allied Hospitals, Harlem Division, Jan. 7, 1912; discharged cured Feb. 12, 1912.

Present History.—Patient is said to have fallen in the street while under the influence of alcohol, so the exact mechanism of the injury is not known. The patient says that his right foot slipped forward and then he fell onto his right side on top of his right leg. The patient was unable to walk and unable to extend the right leg at the knee.

Examination.—Inspection reveals obliteration of the normal topography of the knee, some slight ecchymosis, and a small abrasions of skin over patella. The patella is on a higher level, about 1½ inches, than its fellow of the opposite side; on flexion of the leg upon the thigh the patella does not move downward.

Palpation.—The tendon cannot be felt at the lower border of the patella. The patella itself is very freely movable. A groove can be distinctly felt just beneath the lower border of the patella, running transversely across the knee; no crepitation.

An X-ray picture (Fig. 1) shows the patella tendon pulled away from its attachment to the patella, curved backward and tucked in between the femur and tibia in the intercondyloid notch. There can be seen in the X-ray picture also some fragments of the bone that were pulled away from the patella. The power of extension is totally lost.

FIG. 1.

X-ray before operation. Note elevation of patella and two small pieces of bone pulled away with tendon from patella and driven by atmospheric pressure between condyles.

FIG. 2.

X-ray six weeks after operation.

Operation (Jan. 12, 1912).—The joint was opened by a semicircular incision sweeping downward from the inner condyle around beneath the patella and upward to the outer condyle. The skin and soft parts were retracted; the joint opened and irrigated with 0.5 per cent. carbolic solution. A blood-clot and the torn end of the tendon was withdrawn from its prolapsed position in the intercondyloid notch. The tendon was sutured to the aponeurosis and periosteum of the patella with kangaroo tendon. The lateral expansion of the aponeurosis was found to be torn through almost one-half the circumference of the knee. This was sutured with kangaroo tendon. The skin was then sutured; posterior splint applied. January 24, twelve days after operation first dressing, wound perfectly clean, primary union. Aside from a profound bromide rash the patient had an uneventful recovery. The bromides were administered enthusiastically by the house-surgeon to control alcoholic delirium tremens. The patient, in fact, was in mild delirium for the first three weeks of his sojourn in the hospital.

The tear or rupture of the lateral expansion of the aponeurosis of the quadriceps tendon in this case was no less important than the injury to the tendon itself. The injury to the aponeurosis was very much more extensive than is usually found accompanying fractures of the patella. The fascia lata over the knee is very strong, and receives fibrous extension from the tendon of the biceps externally and from the sartorius internally and quadriceps extensor cruris in front. So it will be seen that through it there are exercised great powers of extension. It is just as important to close this rent in the fascia lata as it is to repair the rupture of the tendon itself. In this case the tear of the aponeurosis was so extensive as to reach through half of the circumference of the knee, necessitating an extension of both ends of our skin incision to reach its limits.

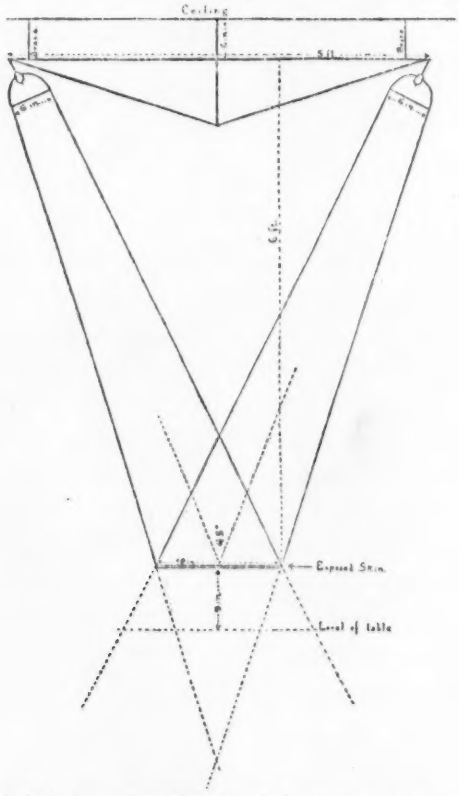
A METHOD OF FOCUSING SEVERAL ELECTRIC LIGHTS ON THE FIELD OF OPERATION.

BY WILLARD BARTLETT, M.D.,

OF ST. LOUIS, MO.

IT is not the writer's primary object to discuss, in this brief article, the relative merits of natural and artificial light-

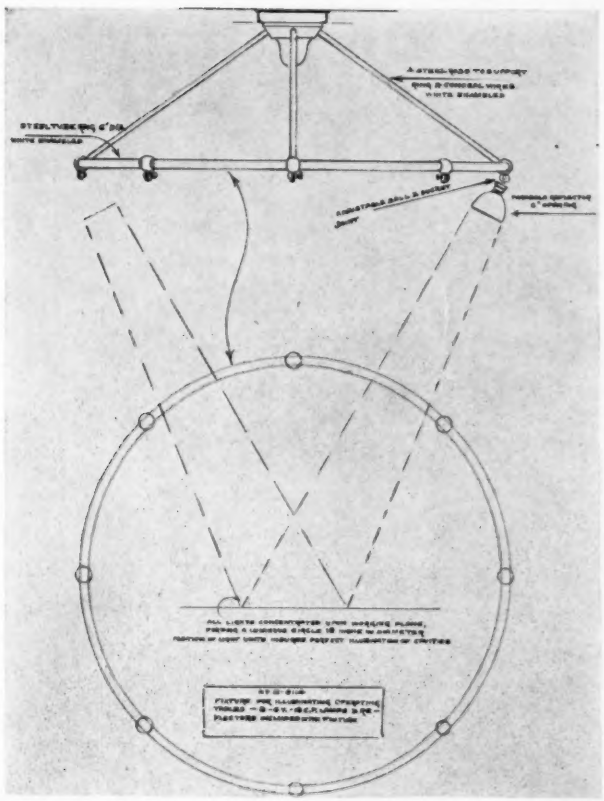
FIG. 1.



Showing how the light is converged from the six-inch reflectors into an 18-inch field.

ing for the operating room; however, it may not be out of place to mention, in passing, the inherent difficulties connected with the skylight, which has heretofore afforded practically

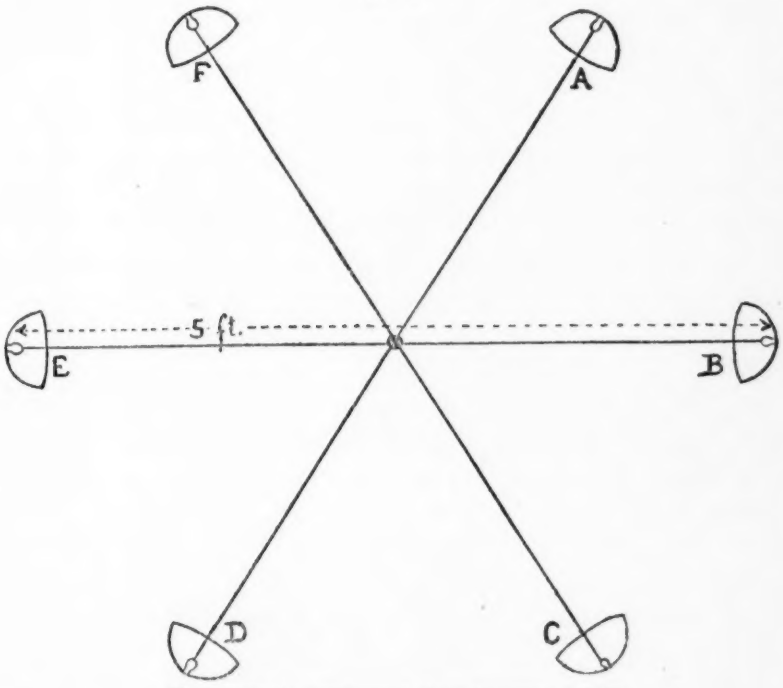
FIG. 3.



Design of an improved apparatus. This represents a development of the original idea, but differs from it in having eight luminous points and being wired "in multiple" whereas the first model was wired "in series."

the only adequate illumination for this purpose. Many of the hospitals which were built before the present decade have *no* skylight, and it may be urged that many such contrivances leak in a hard rain, are difficult to keep clean, especially in cities like St. Louis, where there is much soot, make the operating room as hot as an oven in summer, and in winter are frequently obscured by sleet and snow. Especially is the

FIG. 2.



Illustrating the arrangement of the six sources of light.

double-decked skylight to be condemned, since the lower horizontal deck practically always cuts out an undue amount of light. It goes without saying that the intensity of illumination varies with the hour of the day as well as with the character of the sky, to say nothing of the fact that an operator who is accustomed to a certain quality of light during the daylight hours is dependent upon one with which he is unfamiliar at night.

The above reasoning should not, perhaps, lead one so far as to conclude that the ideal operating room of the future will be constructed without a skylight, but the thought suggests itself forcibly as I employ an artificial lighting system which I recently devised for St. Anthony's Hospital. Two diagrams are submitted which will, I think, make clear the manner in which I have used six electric globes of 15-candle-power with a parabolic reflector behind each. This is the ordinary equipment seen upon modern automobiles, and, as is well known, each light throws a powerful beam, the rays of which diverge but slightly. When six of these, situated at different points, are focused on a given field it stands to reason that the illumination is intense and that in this manner shadows are practically done away with. The source of light is so near the ceiling that no heat from it is noticeable at the level of the operator's head. The globes are frosted and a soft, diffuse glow results. The satisfaction of having a known quality and constant quantity of light at all times is one which will not be fully appreciated by the operator who has not been in possession of it. The fact that beams of light from six sources meet at an angle of more than forty-five degrees naturally cuts out all the shadows which obscure the depths of certain wounds. This will be especially appreciated in certain common duct operations, pelvic procedures, attempts to reach the root of the gasserian ganglion, and others of like nature.

It required some calculating and experimenting on the part of an expert electrician before we secured exactly the "resistance" which brought out the full brilliancy of these tiny six-volt globes. The cost of the material used was less than $25.00—surprisingly little when the result is considered.

Requests for technical information will gladly be turned over to the expert connected with the supply house where my material was purchased.

TRANSACTIONS

OF THE

NEW YORK SURGICAL SOCIETY.

Stated Meeting, held at the New York Academy of Medicine, October 23, 1912.

The President, Dr. Charles L. Gibson, in the Chair.

BANTI'S DISEASE.

Dr. Arpad G. Gerster presented a man, 25 years old, who was admitted to the Mt. Sinai Hospital, on December 3, 1909. The history obtained was that about a year prior to his admission he began to experience a heavy dragging sensation in the abdomen, with slight pain in the back. The pain gradually became more severe, and was located principally in the left hypochondrium and in the lumbar region. The pain did not radiate. There was frequency of urination, both diurnal and nocturnal, with hæmaturia. The patient said he felt weak, and had lost some weight.

Examination revealed a large tumor filling up the entire left upper quadrant and extending somewhat beyond the middle line. This tumor mass had a rounded border and was very mobile, so that it could be pushed from side to side. On inflation of the colon there was tympany in front of the mass. The urine always contained considerable albumin and many red blood-cells; no tubercle bacilli. An examination of the blood gave 4800 white blood-cells, with 85 per cent. of hæmaglobin.

The case was diagnosed as one of Banti's disease, and in December, 1909, Dr. Gerster removed the enlarged spleen through a six-inch incision made parallel to the costal border. The spleen was freely movable, but it was found to be adherent to the stomach above, necessitating resection of a segment of the fundus two and a half inches long. The defect was afterward closed by double suture. The liver was found shrunken and of

the hob-nail type. The abdominal wound was closed, with drainage, and the patient's convalescence was uneventful for ten days, when he developed a high temperature, with remissions and chills and free fluid in the peritoneum. Thrombophlebitis of the splenic vein was suspected, and twelve days after the original operation the abdomen was again opened through a median epigastric incision. There were no evidences of peritonitis, but the abdomen was found to be filled with bloody serum. All the different branches of the portal vein were much distended, the splenic vein exposed by an incision through the lesser omentum being as large as a man's thumb. No clot could be found. The patient's condition at this time was not very favorable, and further operative search was abandoned.

Following this exploratory laparotomy, the patient's temperature ranged between 99° and 102° for two weeks, with occasional chills. Then, after 35 days, it gradually fell to normal; the patient continued to improve, and was discharged, well, on March 9, 1910.

Dr. Gerster remarked that the pain and tumor in the left flank and hæmaturia, which was traced to the left kidney, naturally led to the suspicion that this kidney was either accidentally or coincidently involved with the spleen. As subsequent events showed, the renal symptoms were entirely due to compression, and all the symptoms, including very characteristic attacks of renal colic, which, in fact, was the symptom that had brought the man to the hospital, disappeared with the removal of the enlarged spleen.

Dr. Walton Martin said he had seen a patient with great enlargement of the spleen and slight enlargement of the liver about four weeks ago, and with slight anæmia, and no leucocytosis. The case suggested the one shown by Dr. Gerster. As the patient's condition was fair, and as there had been no hemorrhages, surgical operation had not been advised. The favorable outcome in Dr. Gerster's case would lead Dr. Martin to advise an operation in this case.

Dr. Clarence A. McWilliams said he recently saw a typical case of Banti's disease at the Presbyterian Hospital. The spleen was very much enlarged, and Dr. Joseph A. Blake removed it with considerable difficulty on account of adhesions. Three or four days after the splenectomy the patient developed a tempera-

ture, going as high as 102.5°, and this continued for two weeks without apparent cause. There was no ascites. It had been suggested that perhaps this temperature elevation was an essential feature of the disease itself.

DR. GERSTER, in closing, said that in his case he did not doubt that there was a thrombosis of the portal vein, and such thrombi were usually accompanied by temperatures showing a very steep curve. If the thrombus happened to be of a septic nature, death usually followed, but even under those grave conditions recoveries had been reported.

TUBERCULOSIS OF THE COSTAL CARTILAGES.

DR. A. V. MOSCHCOWITZ presented a negro, 38 years old, who was admitted to the Mt. Sinai Hospital on September 23, 1912, with the history that one year ago his right great toe was amputated at his home for osteomyelitis. Ten years ago there was a genital infection for which the patient was treated with mercury and iodides.

His present history dated back ten months, when there developed a tender mass over the lower part of the right chest. This was incised and drained, and had been discharging pus ever since that time. On physical examination there was found a sinus just below the right nipple, which led to a depth of about four inches in various directions. The axillary, femoral, and epitrochlear glands were enlarged, and there was a tubercular infection of the apex of the left lung.

The patient was operated on by Dr. Moschcowitz, on September 28, in the following manner: A rather irregular incision was made, exposing all the diseased cartilages and one rib. The diseased tissue was then thoroughly extirpated, and the exposed cartilages were covered by flaps of muscular or aponeurotic tissue obtained from adjacent structures, and the entire wound was closed with the exception of that part which corresponded to the necrotic rib.

The sutured portion of the wound healed by primary union. October 19, there was a small collection of serum at the inner angle of the wound, which had to be opened, but the speaker said he did not believe that this led down to the cartilages.

The pathological report by Dr. F. S. Mandlebaum confirmed the diagnosis of tuberculosis.

Dr. Moschcowitz said he presumed he only voiced the sentiments of other surgeons when he stated that tuberculosis of the cartilages of the ribs was rather difficult to cure, no matter how radical the procedure adopted to eradicate it. The speaker said that, as a matter of fact, he had noticed that this was also true when operating upon cartilages in other parts of the body, and he had been led to the conclusion that this failure to effect a cure was due not so much to the inadequacy of the operative method, but to the after-treatment. When operating on such infected tissues, it was quite natural to take recourse to packing the wound with either sterile or iodoform gauze. Here, he believed, was just where the fault lay in our failures to cure these patients. The low vitality of cartilaginous tissues was well known, and they would not tolerate any prolonged contact with gauze. In this case, therefore, he had adopted a different procedure, and a few days before his attention was called to an article by Axhausen, in Langenbeck's Archiv, in which the writer advocated a similar method.

Dr. Moschcowitz said he expected to report the final outcome of this case at a later date.

PROLAPSE OF THE RECTUM.

Dr. Moschcowitz presented a woman, 55 years old, who was admitted to the Mt. Sinai Hospital, in the service of Dr. Arpad G. Gerster, on March 16, 1912. The history obtained was that for the past 25 years she had been suffering with symptoms of a mass protruding from the rectum. These symptoms had become particularly aggravated during the past three years, so that during that time she had made no attempts whatsoever to reduce the mass, which she had previously been able to do.

Examination showed a protruding prolapse of the rectum, about three and a half inches in length. The sphincters were completely relaxed, easily permitting introduction of the entire hand. The surface of the prolapsed rectum was ulcerated from constant friction against the clothing.

Operation, March 21, 1912: The method of procedure in this case was that described by Dr. Moschcowitz in an article entitled "The Pathogenesis, Anatomy and Cure of Prolapse of the Rectum," which was published in *Surgery, Gynæcology and Obstetrics,* July, 1912. Four rows of circular Pagenstecher

sutures were inserted to completely obliterate the pelvis. Primary union resulted, and the patient left the hospital three weeks from the date of the operation. At the present time there was not the slightest evidence of a protrusion, even upon great exertion. The sphincters had regained their normal condition, and the result thus far might be termed an ideal one.

Dr. Howard D. Collins said he thought that Dr. Moschcowitz's idea of obliterating Douglas's cul-de-sac in the treatment of prolapse of the rectum overcame one difficulty which was met with in these cases. His own method had been to suture the lines of the rectum to the peritoneum on the pelvic wall, and his results had been perfectly satisfactory excepting in those cases where the patients had been allowed to become constipated during the period of their convalescence. His method, the speaker said, had a tendency to flatten out the rectum, and if a large mass of fæcal matter was allowed to pass through the rectum, the stitches were torn out or the peritoneum was stretched to such a degree that the benefits of the operation were lost, whereas the method described by Dr. Moschcowitz had a tendency to keep the lumen of the rectum open.

Dr. James M. Hitzrot said he could speak in favor of this method from personal experience. In July of the present year a young woman entered the New York Hospital, presenting a rectal prolapse of about six inches, which she had had since she was a small child—she was now a girl of twenty. Dr. Hitzrot said he operated on her by this method with very good success. He had intended to show her at this meeting, but she left the hospital three weeks after the operation and had returned to her home in Nebraska.

Dr. F. Kammerer inquired if this method was not similar to that described by Quénu and Duval, in the *Revue de Chirurgie,* February, 1910. About a year ago, the speaker said, at one of the meetings of this Society, he showed a patient upon whom he had done the operation, as described by these two authors, apparently with very satisfactory results. The patient was a woman with a rectal prolapse of four or five inches, which he had previously tried to correct by various expedients but without success. The prolapse was originally of traumatic origin. After carrying out the method described by Dr. Moschcowitz, the patient remained well for about ten months; then the prolapse recurred.

Dr. Kammerer said that in dealing with this condition of rectal prolapse he had seen good results following various operative expedients, including that of Dieffenbach of excision of the posterior wall of the rectum, together with the sphincter; also by denudation of the iliac fossa and attaching the bowel to the denuded surface. The success of the operation depended largely upon the kind of prolapse one had to deal with.

Dr. Henry H. M. Lyle said he had tried the method described by Dr. Moschcowitz in a case of prolapse of the uterus, with descent of the posterior wall. In this case, closure of the cul-de-sac of Douglas gave very good support. The operation was done two months ago, and the patient's condition was thus far very good.

Dr. Gerster said his experience with the various operations for the correction of rectal prolapse had been very similar to that of Dr. Kammerer, and while the results of many of these procedures were excellent, they were, unfortunately, only temporary. The studies of Dr. Moschcowitz had demonstrated that the failure to obtain permanent relief was due to the fact that we had neglected to seek out and correct the real causative factor of this condition, *i.e.*, that a prolapse of the rectum was always due to a laxity of the pelvic floor, and this could not be better remedied than by the method employed in the case shown at this meeting. Of course, the method was still in an experimental stage, but it came nearer the purpose than any of the two score or more plastic procedures that had been recommended and tried heretofore. In women, the operation described by Dr. Moschcowitz was comparatively simple; in men, it would sometimes prove very difficult. If a sufficient number of sutures were placed, the final outcome of the operation, which was still in doubt, should be very good.

Dr. Moschcowitz said that entirely aside from making any claim of priority for this method of operation, he merely wished to call attention to the fact that Quénu and Duval published their article on the subject in the *Revue de Chirurgie* in 1910, while he did his first operation by this method fully five and a half years ago. The speaker said that while abroad this summer he discussed the subject with Dr. Quénu, who had informed him that the idea of their operation was essentially a colopexy. In this connection he might call attention to the fact that over ten

years ago Bardenhauer operated on these cases by a method not unlike that of Quénu and Duval.

DR. KAMMERER said that in the remark he made he did not have in mind the question of priority. He had not yet read Dr. Moschcowitz's recent publication and, before discussing the subject, wished to know if the two procedures are based on the same principle of technic.

TUBERCULOSIS OF THE SHAFT OF THE LONG BONES.

DR. FRANK S. MATHEWS showed three cases of tuberculosis of the shaft of the long bones not involving the adjacent joints. In the first case, a focus in the lower end of the humerus had made a fusiform swelling above the elbow. The tuberculous segment had been excised subperiosteally and the wound closed. The segment had re-formed in two months.

In the second case shown there was tuberculosis of the whole shaft of the humerus, with many sinuses, but no X-ray or clinical evidence of joint involvement. Early treatment like that in the first case might have resulted in a cure without the present extensive involvement of bone and soft parts.

The third case was a tuberculosis of the lower half of the shaft of the femur. An abscess and sinus had formed, and the bone destruction had been considerable. The child's condition was desperate. Subperiosteal resection of the lower half of the femur down to the epiphyseal cartilage of the knee had been done. Bone had re-formed, but there was still a sinus.

Dr. Mathews, while in general advocating the orthopædic rather than the operative treatment of joint cases, urged the wisdom of early diagnosis of foci in the shaft or ends of diaphyses of the long bones, and their early subperiosteal removal to prevent joint tuberculosis and to curtail the period of treatment.

DR. MARTIN, referring to an X-ray negative which he had shown in connection with the cases presented by Dr. Mathews, said the case was that of a child, two and a half years old, where a large section of the shaft of the ulna had been removed for tuberculosis. There were no sinuses, and the child made a good recovery without involvement of the joints. The case was exactly similar to those reported by Dr. Mathews.

DR. RUSSELL said he was interested in the statement quoted by Dr. Mathews that a resection of the shaft did not interfere

with the growth of the bone, as there was a rather wide-spread belief among surgeons that resection of the long bones in children might result in possible shortening. The speaker said there were several cases of compound separation of the lower epiphysis of the femur in which the diaphysis had been resected, resulting in progressive shortening extending over several years.

DR. GERSTER said that Dr. Mathews, in his presentation of these cases of tuberculosis of the shaft of the long bones, touched upon a very important surgical principle. In the early days of aseptic surgery, when we first began to attack tuberculous joints under the leadership of Professor Volkmann, the tendency was to go too far, and primary resections were very common until we were frightened from that extreme position by the observation that many cases of miliary tuberculosis followed these extensive surgical procedures. The dictum then taught that tuberculosis of the joints should be regarded and treated like a malignant disease was gradually abandoned, and we swung back to the other extreme and turned these cases over to the orthopædists, who achieved such brilliant results with orthopædic measures combined with general treatment that radical surgical interference was rarely resorted to.

In the cases shown by Dr. Mathews the fact was demonstrated that when we had to deal with a tuberculous focus either in the diaphysis or epiphysis of the long bones where perforation into the joint was to be feared with reasonable certainty, it was rational to cut down and remove that focus. This was one of the teachings of Volkmann, and now, when, with the aid of the X-rays, an early and accurate diagnosis could easily be made, this operation deserves to be characterized as eminently conservative.

DR. MATHEWS, in closing, replying to Dr. Russell, said that in making the statement that resection of the shaft of the bone did not interfere with its growth, he had quoted Stiles as authority for the statement.

Dr. Mathews said that in the three cases he had shown, the conditions were not ideal. In dealing with an early tuberculosis of the shaft, he thought it was better to do a resection than to rely on the expectant treatment, with the risk of perforation into the joint. Personally, he was strongly opposed to a resection of the hip in a child, as the result was usually very bad, with de-

cided shortening. After such a resection, the arrest of growth was not limited to the hip, but involved every epiphysis from the hip down to the toes, and the resulting shortening was very pronounced, sometimes as much as ten inches. Dr. Mathews said he had never seen this fact mentioned in the text-books.

Dr. Royal Whitman said he had thought it well known that in cases of hip-joint disease in childhood, whether operated on or not, or whenever from any cause there was loss of function for a long period, growth was checked in some degree, not only in the bone directly involved, but in all the bones and tissues of the limb.

TRAUMATIC SEPARATION OF THE LOWER EPIPHYSIS OF THE FEMUR.

Dr. James I. Russell read a paper with the above title, for which see page 869, vol. lvi.

Dr. Gerster said that one of his earliest surgical experiences dated back to the year 1872 or 1873, while serving as assistant surgeon in the Austrian army. One day a young recruit was struck on the head by a heavy straw mattress, which had been thrown from one of the upper floors of the barracks. Upon recovering consciousness he was unable to walk and complained bitterly of pain in one of his legs. A dislocation of the knee-joint was suspected: crepitus was felt, a large hæmatoma rapidly developed, and separation of the epiphysis was diagnosed. The fragments were easily replaced, and the patient eventually recovered with good use of the limb. The toes being cold, this and the presence of the hæmatoma led to the suspicion that a large vessel might have been ruptured. This fear proved to be groundless.

BOOK REVIEW.

SURGICAL AFTER-TREATMENT. By L. R. G. CRANDON, M.D., Assistant in Surgery at Harvard Medical School, and ALBERT EHRENFRIED, M.D., Assistant in Anatomy at Harvard Medical School. Second edition, practically rewritten. Octavo of 831 pages, with 264 original illustrations. Philadelphia and London: W. B. Saunders Company, 1912.

THIS work, now in its second edition, has been thoroughly revised and in large part rewritten. It is intended to appeal especially to hospital residents, surgical assistants, and those who are called upon to care for surgical cases in communities which are not hospital centres.

Although completely modernized, most of its contents are teachings which have stood the test of time, and which represent not only the originality of the authors but also the generally accepted thought and practice in the care of surgical patients.

The work is divided into two parts, the first of which contains chapters given to the consideration of subjects of general interest, such as the arrangement of the sick-room, the nurse's chart, post-anæsthetic nausea, pain, shock, coma, hemorrhage, pulmonary embolism, and artificial respiration. Then follow chapters on diet, rectal feeding, catheterization, the care of the bowels, acute gastric dilatation, and post-operative intestinal obstruction. Bandaging, the management of the operative wound, dressings, removal of sutures, and the subject of drainage are next considered, together with the management of infected wounds, sinuses and fistulæ. Part I is concluded with a consideration of the indications for massage, X-ray therapy and radium, and somewhat out of order, so far as the arrangement of the text is concerned, is here added a chapter on the preparation of the patient for operation.

In Part II the management of post-operative conditions is considered in regional form, a chapter being given to each of the various regions of the body and to each group of organs or tissues of similar structure. In these chapters are discussed not

only the normal cases but also the management of the various complications and abnormalities to which each one is subject.

One of the most valuable contributions to the work is the chapter on therapeutic immunization and vaccine therapy which was prepared by Dr. George P. Sanborn. It is thorough and at the same time concise, and presents all of the more important essentials for the application of this valuable adjuvant to surgical science.

A complete index of authors is appended, and the text is liberally interspersed with charts, drawings, and photographic reproductions, most of which are original and serve well to illustrate the methods and ideas as described in the text. On the whole, the book is a very satisfactory and comprehensive treatise on the subject of surgical after-treatment and serves admirably the purpose for which the authors have intended it.

WALTER A. SHERWOOD.

THE PITUITARY BODY AND ITS DISORDERS. By HARVEY CUSHING, M.D., Associate Professor of Surgery, The Johns Hopkins University; Professor of Surgery (Elect), Harvard University. Octavo, 341 pages, 319 illustrations. Philadelphia and London: J. B. Lippincott Company, 1912.

ONLY at rare intervals in the history of medical literature does a book appear which stands out as something striking and fundamental. Such an epoch-making volume is Cushing's recent classical monograph on hypophyseal disease. Though numerous scattered papers have been published in the past twenty-five years, and especially in the last decade, on the disorders of the pituitary body, it has remained for an American surgeon to give to the world for the first time a systematic and crystallized conception of the varied clinical manifestations resulting from pathological lesions of this organ. The book is no mere compilation of the literature, but is mainly the result of a most extensive personal clinical experience and experimental research, and it will undoubtedly rank as the reference work of the future on the diseases of the hypophysis cerebri. It is possible that some of Cushing's deductions may be disproved by coming investigators, yet it is certain that his book will stand out pre-eminent as the first attempt to present in a concrete scientific form a com-

plete picture of the various clinical states produced by disease of the pituitary gland.

The volume is an outgrowth of a lecture delivered before the Harvey Society in December, 1910. The twenty cases, on which this lecture was based, were more than doubled in the succeeding nine months. From these two-score odd accurate clinical studies and extensive experimental work, of which only a portion has already been published, this book has developed.

In Part I, the morphology and histology of the gland, including its mode of secretion, the question of accessory glandules, and its circulation, are briefly considered. Considerable space is devoted to the known facts of hypophyseal physiology, obtained by the injection and ingestion of extracts, by glandular transplantation, and by extirpation methods. As is well known, it is the last of these methods that has given us the most information, and Cushing and his assistants have contributed not a little to our knowledge on this score. He believes with Paulesco that total hypophysectomy is fatal and that the lethal outcome is due in the main to the loss of the anterior lobe. His results with partial hypophysectomy are also incorporated, and from these have been obtained the first experimental proof that certain hitherto imperfectly understood clinical phenomena are due to lessened glandular activity or hypopituitarism. He has reproduced the adiposogenital dystrophy of Bartels or the Froehlich type in puppies, and, what is still more significant, he has succeeded in producing a post-adolescent form with adiposity and sexual atrophy in adult canines.

In this section he also calls attention to his thermic reaction found upon injection of pars anterior in anterior lobe deficiency. He utilizes this as a diagnostic test. The necessity of normal posterior lobe activity to effective carbohydrate metabolism is also considered. Glycogenolysis and emaciation occur after injection of posterior lobe extract, and adiposity and high sugar tolerance are found in posterior lobe deficiency. Part I is concluded by a somewhat too brief discussion of the pathology and chemistry of the organ.

Part II, which is really the body of the work, is devoted to an admirable clinical analysis of a series of forty-seven cases, which Cushing has had the opportunity to study in the past two years. He has grouped these cases of dyspituitarism into an original

classification, which he himself modestly suggests as provisional, but which for the present is certainly an excellent working basis.

He forms five main divisions, as follows: (1) cases with marked neighborhood and glandular symptoms; (2) cases with marked neighborhood but absent or inconspicuous glandular symptoms; (3) cases with marked glandular but absent or inconspicuous neighborhood symptoms; (4) cases of obvious distant cerebral lesions with accompanying symptoms of secondary involvement of the hypophysis; (5) cases of polyglandular disease.

The first four groups are subdivided into (*a*) predominant hyperpituitarism; (*b*) predominant hypopituitarism, and (*c*) mixed or transition cases,—dyspituitarism. In subdivision *a* we have (*x*) the pre-adolescent form or gigantism, *typus Launois*, and (*y*) the post-adolescent form or acromegaly, *typus Marie*. In *b* we likewise find (*x*) the pre-adolescent form, adiposity with skeletal and sexual infantilism, *typus Froehlich*, and (*y*) the post-adolescent form of adiposity with sexual atrophy, the type which Cushing has produced experimentally, of which he gives clinical illustrations, and for which the reviewer would suggest the title, *typus Cushing*. Among Cushing's cases are found examples of the majority of the various main groups and their subdivisions.

As Cushing points out, the main defect in this classification is due to the dual nature of the gland, which has an anterior lobe associated with growth and a posterior lobe affecting tissue metabolism. Hence, one or both lobes may be involved, either or both may be over- or under-active, the over- or under-activity of either or both lobes may begin in infancy or in adult life, and finally the over-activity of either or of both lobes may be followed by an insufficiency of either one or both parts of the gland. The innumerable combinations can readily be imagined, and it will be seen that it is necessary to interpret each individual case on its merits, as Cushing does, and that one cannot be content with placing this or that case into an arbitrary class.

The above classification applies primarily to cases of gross lesions, particularly tumors, of the hypophysis. The question is further complicated by the possible existence of a merely functional over- or under-activity of the gland without demonstrable anatomical changes.

The case histories are fascinating reading. They are not

the usual compilation of dull historical data, for aside from the fact that the cases themselves are out of the ordinary, they are described in so interesting a fashion that the reader frequently feels he is actually becoming acquainted with this or that particular patient, just as one learns to know a character from a novel or a biographical sketch. The summary of the hypophyseal symptoms and the epicritical analysis in each case deserve special commendation. The histories are further enlivened by excellently chosen photographs, and by radiographs of the sella and extremities, which are reproduced in their natural size. Perimeter charts, photographs of pathological specimens, and microphotographs of the pathological findings are added wherever possible.

Part III is devoted to an analytical review of the incidence, the symptomatology, and the treatment of hypophyseal disease based mainly upon the author's personal experience. It would be impossible in the space allotted to me to give a satisfactory abstract of this portion of the book. Every sentence is significant, and I shall only indicate the general trend of the argument. Each particular symptom, neighborhood, general pressure, glandular, and polyglandular, is carefully analyzed and its relative importance dwelt upon. Three new cases are added to illustrate hypophyseal glycosuria and hypophyseal epilepsy. Perhaps a trifle too much stress is laid upon the significance of glycosuria in hyperactivity and increased carbohydrate tolerance in insufficiency of the posterior lobe.

The lesion itself, certified in twenty-nine cases, is next discussed, and finally the question of treatment is taken up in detail. The indications for surgical intervention, namely, to relieve the general pressure symptoms, to combat the functional hyperplasia, and to relieve the neighborhood symptoms, are considered *seriatim,* and the various methods of approach are reviewed.

For direct sellar approach Cushing has finally adopted a one-stage transphenoidal operation with sublabial incision and submucous septal resection. This is practically a combination of Kanavel's inferior nasal and Hirsch's endonasal operation. Every effort should be made to avoid lacerating the mucous membrane, and the turbinates are flattened out by retraction and dilatation, but not removed. The use of urotropin as a preventative against meningitis, and the importance of careful radio-

graphic study as a means of orientation, the necessity of perfect anæsthesia, and the danger, if one's direction is wrong, of perforating the cribriform plate of the ethmoid, are emphasized.

By the transphenoidal approach local sellar decompression, partial extirpation, or cyst evacuation may be accomplished. A subtemporal approach may be used for simple decompression, especially in superimposed lesions, or for combined decompression and exploration. Finally both avenues of approach, intra- and extracranial, may be combined. Cushing has performed these various operations either single or combined on 43 patients, who have been subjected, all told, to 61 operations. A table of these cases is appended. Of the 43 cases, only 28 are included in Part II, and 15 are new cases added since the completion of that portion of the work. Cushing has had by far the largest individual operative experience, and his results are, for this reason, if for no other, of the utmost significance. The mortality in 29 actual transphenoidal attacks was only 13.7 per cent. The main result of operation has been the relief of neighborhood symptoms. Symptoms of intracranial tension are likewise improved, and it is hoped that hyperpituitarism may yet be influenced. Glandular implantation in hypopituitarism is looked upon as a further possibility of surgical intervention. Further, a preliminary sellar or subtemporal decompression, or both, is suggested as a means for more effective radiotherapy.

The matter of glandular therapy in hypopituitarism by ingestion and injection is next taken up. Cushing has seen some very definite results from these measures, particularly as far as the adiposity and the subjective symptoms resulting from glandular insufficiency are concerned. An ingenious suggestion for determining the dosage is offered. The patient should be given daily enough glucose to cause glycosuria in a normal person of equal body-weight and then increasing amounts of glandular extract are given till a trace of sugar occurs in the urine of the patient, who, of course, originally had an increased tolerance. Injection is the more effective measure, and in two cases overcame the somnolence, when feeding failed.

The possibility of the beneficial effects of glandular transplantation are considered, and one case is recorded in which Cushing had the opportunity to carry out this procedure. The result was extremely satisfactory.

X-ray treatment, especially in combination with operative measures, promises to be useful in cases of strumous hyperplasia, especially where the tumor symptoms predominate. Neighborhood and pressure symptoms have both been influenced in some of the later cases, and it is suggested that the X-ray may effect the growth of cells in the struma, much in the same way as the cell division of the spermatogenous epithelium of the testis is arrested.

An exhaustive bibliography of 256 numbers completes the volume.

Possibly some will feel that Cushing is a trifle too speculative in his inferences and somewhat over-enthusiastic in his conclusions. These attributes, which give the work a distinct individuality, merit rather praise than condemnation. Would any scientific progress be possible without a certain amount of imagination and optimism on the part of the investigator? Cushing's book is a great step forward, and it will be an enduring monument to the earnest and able efforts of its author. The volume should be in the private library of every physician, for there is practically no specialty in medicine which is not overlapped by the subject under discussion. Of especial importance, however, is the book to the surgeon, for it is from him that the definite practical results are to come in the treatment of those unfortunates suffering from pituitary disease. DE WITT STETTEN.

FIG. 1

Acute suppurating subdeltoid bursitis.

CORRESPONDENCE.

ACUTE SUPPURATING BURSITIS OF THE SUBDELTOID BURSA.

EDITOR ANNALS OF SURGERY:

As instances of acute suppurating inflammation of the subdeltoid bursa are not common, the report of a case with the ultimate results may not be out of place.

W. C. R., male, aet. 40 years, was first seen on September 15, 1909. A strong, well-built man, who had always enjoyed excellent health. He had never contracted gonorrhœa nor syphilis. For two days before coming under observation the patient began to experience severe pain in the right shoulder. The pain came on suddenly without any known cause, and increased to such a degree that within forty-eight hours the patient was in real agony.

Examination showed no change in the shoulder by inspection. Palpation revealed nothing excepting some pain over the deltoid, but any movement of the shoulder would cause great pain. Local applications and the internal administration of natrii salicylate gave no relief after two days' trial, the pain continuing so severe that morphine had to be given. Temperature was always normal.

On September 18 the shoulder was radiographed and a distinct outline of the subdeltoid bursa was revealed (Fig. 1) and the correct diagnosis arrived at.

Operation was done on September 19, with the kind assistance of Dr. F. J. Cotton. A posterolateral incision ten centimetres long was made, the fibres of the deltoid separated by blunt dissection, and a tense subdeltoid bursa readily brought to view. Upon incision, about five cubic centimetres of thick yellow pus escaped, which was unfortunately lost for bacteriological examination. The bursa was easily extirpated and a small rubber-dam cigarette drain inserted, after which the wound was closed. Drain removed in forty-eight hours.

The arm was put up on a Munk's rectangular splint, which was worn for three weeks, after which passive and active motions

were begun, with the result that within six weeks after the operation the patient had very fair use of the arm. At the present time of writing (October 12, 1912), three years after the interference, the patient has a perfect functional result.

The obscurity of the etiological factor in this case is interesting, as the patient had never had a urethral infection, nor had he received any trauma to the shoulder. He has been in perfect health ever since.

CHARLES GREENE CUMSTON, M.D.,
Boston, Mass.

OPERATION UPON A NEW-BORN BABE.

EDITOR ANNALS OF SURGERY:

The rather infrequent occurrence of operation work on babes, made necessary, however, at times, is well illustrated in the following case: A male child born to Mr. and Mrs. Harry Elliott at 11 o'clock P.M., September 13, 1912, under the professional care of Dr. James A. McMurray, of Marion, Ohio. The babe had an embryonal cyst of the cord, near the body, size of a large double fist, as well as an umbilical hernia which was really more an eventration than an umbilical rupture. On consultation it was decided to give the babe a chance by operative surgery, rather than trust nature. The babe was, therefore, sent to the hospital, anæsthetized with chloroform by Dr. H. J. Lower, the mass excised, and the umbilical hernia reduced and sutured. The operative work was done on this babe exactly fourteen hours after birth. It bore the anæsthetic well, and made an uneventful recovery.

AUGUST RHU, M.D.,
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